CIRCUITS
OF
VICTORY
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A. E. F. TELEPHONE AND TELEGRAPH LINES

Black lines indicate U. S. construction; Blue, U. S. wire on French poles; Green, lines leased from the French, and Red, lines built or taken over in Germany.

The U. S. Signal Corps constructed 1,990 miles of permanent pole lines, with 28,000 miles of wire; put up 3,230 miles of wire on French poles, and installed approximately 40,000 miles of combat lines. In addition, 20,400 miles of wire were leased from the French. Telephone exchanges on permanent lines numbered 273; those in the advance section 123, but the small temporary field installations were much more numerous. On Armistice Day, a total of 396 telephone offices were serving nearly 15,000 telephones and a total of 191 telegraph offices.

Circuits of Victory

By

A. Lincoln Lavine

Formerly Captain, Air Service, U. S. A.
Formerly with the American Telephone and Telegraph Company



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INTRODUCTION

You remember the Magic Mirror, presented by Merlin to his king.

It was a wonderful mirror. You gazed into its polished depths and lo! you saw, at a glance, all plots, treasons and invasions going on about you. You looked straight into the minds of all your subjects, penetrated their every thought, divined their every instinct. Past and present could be called up at will. Nothing was hidden. Joy and anguish, tumult and tedium, clash of clan and quiet of cloister—the mighty surge of all mankind moved in majestic array before your very eyes.

What a blessing to the modern historian! What a short-cut to history! What an eye opener!

Nothing short of a magic mirror can tell us what has really happened during the past six years. We are like children who have witnessed a gigantic upheaval of nature. Our senses react, but fail to register.

Do you know, do I know, do we really *know* the significance of that stupendous event which first-blush historians are beginning to call The Great War?

Why, it is like a confused, tumultuous dream; something we have read about; something we pictured having passed through.

And only yesterday——

* * * * * * *

It was the spring of 1918. Wise heads predicted dolefully. It was the end. The decent world was about to die. The Hun was making his last desperate plunge. Nothing could stop him. His hordes were pouring through huge gaps in the Allied line, tearing their way madly, irresistibly, through a crumbling wall, tumbling closer and ever closer toward Paris. A movement to encircle the Allied line and overwhelm the channel ports, and then—finis! No further help could come. Prussia enthroned. The rest of the world her footstool.

We had arrived too late—had we not? What could be done? Civilisation on the brink—hanging on by its very nails—wavering—weakening—exhausted—about to drop into the abyss—and then . . .

American Official Communiqué No. 22, dated June 5, 1918. It began with a paragraph or two describing several aerial engagements. There followed a few paragraphs about some minor patrol activities. Finally, there appeared a quotation from a French report. The American public read it, and never dreamed they were witnessing the thrilling climax of the most amazing plot in all history.

What had happened was something like this:

The crisis had come. The Prussian attack resembled a huge triangular wedge, the western side running fifty miles northward from the Marne to the Oise, near Noyon, the eastern side running northeastward thirty miles to Rheims, the point of the wedge resting on the north bank of the Marne at the little village of Château-Thierry—forty miles from Paris.

On to Paris! Orders of the German High Command (revealed later) were, "Get to the south bank of the Marne at all costs."

The Germans never got there. A book might be written to tell why. But it can all be summed up in these words: The Americans were on the south bank. The Prussian did everything possible to get a foothold on that bank. All his weight was concentrated there. His best legions were sent to accomplish the deed. His artillery poured a cloudburst of shellfire upon the defenders. A mouse could scarcely show itself without being annihilated. Wave after wave, pouring through the narrow streets of this little village, attempted to sweep over the bridges separating the north and south banks. Of no avail. The gallant little band of Americans held fast. German dead were piled high on the bridges separating the two banks. Stubbornly, unyieldingly, the bridges were defended, then blown up, choking the Marne with German dead. Not a German crossed.

To the northwest, the Marines met the Kaiser's best, marching forward "nach Paris" in the full flush of victory; and turned them back—amazed, stupefied, demoralised.

Donnerwetter! What had happened?

The Americans had happened.

The peak had been reached. The Hun had been stopped. The world breathed again.

Came the counter-attack. Our men fought like novices—and like heroes. The Germans broke and ran. Gone was their offensive, forever lost.

Came the 6th of June, when the Marines began to carve their name into history at Bois de Belleau. Human flesh advancing upon hell—a thin line between Paris and the enemy—melting fearful casualties—but sweeping everything before it.

Came the Aisne-Marne Allied offensive, catching the

enemy in a huge pocket from which he extricated himself only with huge loss in killed, wounded and captured.

Came St. Mihiel, the first distinctly American offensive, wholly under orders of the American Commander-in-Chief; costing 7,000 casualties; netting 16,000 prisoners and 443 guns; flattening out in twenty-four hours a dangerous enemy salient of four years' standing.

Came the Meuse-Argonne; the key to the western front; the backbone of the Prussian position, where ran the Sedan-Mezieres railroad, the main line of supply for the German forces; which, cut, meant German retirement on the whole front, including evacuation of the Briey iron fields—an irreparable loss. It must be defended at all costs, was the word from the German High Command. Every available German division was thrown in to meet the attack. Every available American division was thrown against the enemy. The object of the attack, said General Pershing, was "to draw the best German divisions to our front and consume them." At the end of 47 days of continuous battle, the best German divisions had been drawn to our front and consumed.

The Prussian backbone was broken. "Armistice or disaster," wired Ludendorff.

Armistice.

A frenzy of joy sweeps over the civilised world. Victory complete—the forces of darkness overthrown—right triumphant—peace!

What a tempest! Four years of agonised warfare sweeping furiously over the Continent of Europe; spreading to Asia, to Africa; involving thirty nations and scores of races; nearly ten millions slain in battle; thirty millions injured; thousands blinded and made insane; no country free from its terrible ravages; millions of non-combatants—mothers,

little children, nurses, teachers—slain on the high seas, snuffed out by disease, wasted by starvation; and then, at the height of the horror, the world aghast, America plunges into the hottest and thickest of the fray—just in the nick of time—blunts the nose of that terrible Prussian wedge—turns the terrific forward momentum into a backward sag—and before many months the menace is met, the turmoil is at an end, the threatened blight upon civilisation is averted—

* * * * * * *

And here we are, back at our desk, shop, store, farm, mill, counter. Again we are wondering whether Neighbor Jones will buy a new automobile this year. Again we are praising or criticising last night's play, eating all the sugar we like, devouring, without a thought of Hoover, the lordly tenderloin or the plebeian corned beef and cabbage, pondering a new suit of clothes, wondering how many rounds the new contender for the prize-fighting championship will last, puzzling our heads over the Mexican problem, which, like the poor, we have always with us, growing excited over the front-page spread about the transfer of a famous "star" from one baseball club to another.

And yet, what an epic we have just witnessed and taken part in! What a colossal drama of passion and pathos, of love and hate, courage and fear, base descent to animal lust and sublime devotion to the highest ideals! What a conquest of fact over fiction! It needs only to be told. Who will tell it?

I do not believe the man lives who can comprehend it all—yet. Excellent attempts are being made to reduce it to black and white—stretched over a dozen volumes. But can anyone, to-day, really tell the story of "The Great War"? Why, he cannot get far enough away from it! As well try

trated every phase of our business and social life. By it, money was moved, trains were dispatched, buildings, bridges, tunnels, reservoirs and all sorts of public works built, carriages and cars called, employees secured, emergency help summoned—the whole machinery of American civilisation kept going.

That explains why a wire girdling the earth four times at the equator would not equal in length the amount strung in Europe by the American Signal Corps. It explains why, during the war, Marshal Foch would go out of his way time and again to use an American telephone in the field; why General Pershing was able, in the language of Major Powell, "to pick up his telephone receiver in his private car, sidetracked hundreds of miles away from the battlefront, perhaps, and talk, if he so desired, with a subaltern of infantry crouching in his dugout on the edge of No Man's Land." It explains why, during the crucial days of October, 1918, according to the records of the First Army, the amount of telephone business handled daily at army headquarters was more than 75,000 messages. It also explains why, when the Second and Thirty-sixth Divisions were sent over above Somme-Py to break the tenacious clutch of the enemy, the following radio message was received at a divisional P. C. (post of command) from a brigadier general commanding the attacking brigade: "I am absolutely out of all communication." Which reminds one of Pat's anxious query, "Is it dead that you are, Moike?" And Mike's response, "Faith, no, but I'm knocked spacheless!" To this brigadier general, the loss of telephone communication was equivalent to the loss of all communication—he was "knocked spacheless."

And then, consider the nature of the war just ended. It was different from any other war that ever was.

In all previous wars, there was the army, *and* the people. The army marched off to do battle, while the people lined sidewalks, or gazed through windows, and cheered. Army met army, was victorious or vanquished, returned to its native shore, and was cheered again from throats comparatively free from the lump that rises when we see our own immediate flesh and blood returning to us. They were just "our soldiers coming back."

But this was a war in which the army and the people were one and the same. Some wore khaki, some didn't, but all fought, with weapons suited to sex, age, talent and training. All the instruments of peace became, on the instant, instruments of war. And just as our telephone had been one of our most effective instruments of peace, it became one of our most formidable instruments of war.

The general on the foaming charger, the messenger who arrived in breathless haste with the dispatches that spell victory or defeat,—these were replaced by the army telephone exchange, the dugout switchboard, the advancing reel cart, the portable camp telephone.

Battle lines extended no longer a paltry few thousand square yards, or, at the most, a dozen or two square miles. They flung their gargantuan length across a continent. They reached back over three thousand miles of submarine-infested water. It is a justifiable figure of speech to say that they crossed and recrossed the entire length and breadth of America's three million square miles. Their maintenance absorbed the entire energies of the American people.

But the underlying principle of warfare was the same: concentration of force. That army which could fight best as a unit would win. Think of it! Unity of command over millions upon millions of combatants: to co-ordinate and

concentrate their efforts as a single unit! And then consider the almost miraculous way America girded her loins for battle at the eleventh hour: one day quiescent; the next day bursting with war activity; and the next, the decisive factor in the world struggle,—and there you have a conception of what I mean by The American Idea.

As the Chief Signal Officer of the U. S. Army has put it:

> The importance of inter-communication in warfare cannot well be exaggerated. The element of time is a controlling one in strategy and tactics, and as the distances become greater, the electrical method of inter-communication surpasses all others in increasing ratio. Unity of command, which the Allies were so slow in realising, can reach its full value only when the most perfect system of inter-communication is established and maintained between general headquarters and the larger units and between these units and the smaller units to the man on the firing line. . . .
>
> The telephone art, which stands to-day as a monument to American genius, every essential feature of which can be traced to American origin, is efficient over all others for the fundamental reason that it vastly extends the reach of the human voice and permits the use of language directly in signalling. This means that practically every individual is an expert signalman, and in the United States there is no region so remote but that it may not be joined at present to any other region by direct speech.

Not that the telephone "won the war." In a struggle so vast, pregnant with such awe-inspiring possibilities for good or evil, all so nicely balanced that not till well toward the end was the end itself visible,—no individual, no group, no nation, may presume to monopolise the credit for the final result. Everything counted. If this were a "We-Won-the-War" book, it would not deserve to be read—or written. For whoever claims The Great Victory as a personal, corporate or national monopoly, misses the spirit of the whole triumph. It was not a victory won by any army or collection of armies,

any group or collection of groups. It was a victory won by a principle—a principle in action, moving millions, all differing in language, habits, environment, everything—except one thing: the principle; the principle that there is something in this world superior to force. On that they were one. On that they won.

The point I would make as to The American Idea is this: To understand the British effort in the war, you must study the keen discernment of her bankers, merchants and ocean traders, the phlegmatic doggedness of her miners, factory workers and clerks, the cool relentless courage of the race. To understand the French effort, you must appreciate the spirit of fiery resentment engendered by 1871, the fervor of French nationalism, the simple force of the Marseillaise upon the soul of every Frenchman; that devotion to ideals which, even in the darkest hour, maintained an undiminished flame of heroism. To comprehend the American effort, you must understand the impatience of the American at any delay, his passion to get things done, his genius for short cuts.

It is not a mere accident that the first French phrase invariably acquired by the American soldier in France, was "toute-de-suite," "Right away, quick." And the truest expression of this spirit that I know of, is the American telephone. In the history of the American telephone in the war, we find a reflection of the American people in the war.

Nor is it by any accident that the telephone was invented in America, reached its fullest development and highest use in America, grew from a crude toy, which people picked up in 1876 to exclaim, "My God! It talks!" down to the time when the spoken word, guided by American engineers, crossed the continent of North America, leaped through space

from the United States to Hawaii on one side, to Paris on the other; directing planes in the air and ships at sea; fully prepared to take its part in the greatest of all wars as one of the most formidable offspring of American enterprise.

It was The American Idea in action. It was the everlasting substitution of "toute-de-suite" for "to-morrow." It was the point-blank refusal of unfettered democracy to accept a single limitation imposed by tradition; an implacable scorn for the word, "impossible." It reveals the contrast between the Old World, which says, "Experience has demonstrated that this thing cannot be done," and the New World, which says, "It can't be done, but we're going to do it!"

So when people said, "There's no use fooling ourselves, Germany is winning the war, she is absolutely invincible, her efficiency is terrible, her system unbeatable, it is impossible to overcome it,"—when the world, bullied into pessimism by an apparently insuperable obstacle, cried, "It can't be done," America answered, "Out of my way, I'm busy!" and did the impossible.

Now, this same American Idea, this continuous slaughter of impossibilities, this tireless and intrepid spirit which, in the space of a few months, shattered an apparently hopeless stalemate, averted impending defeat, tore through what seemed to be an utterly hopeless barrier to victory; the same spirit that converted thirteen agricultural colonies into a foremost industrial and commercial power, without whose counsel no nation will ever again attempt a world movement,—that same spirit may be caught on the wing, as it were, examined and understood, if you will take what Arnold Bennett calls its "proudest and most poetical achievement," and follow through a history of the telephone effort of America during the war.

It will not be a history of telephones. It will be a history of human beings: an American family of two hundred thousand men and women bound together by kindred ties of service; converted suddenly from peaceful citizens to warriors equipped with deadly technique; pouring their combined energies into a thousand different channels of war; touching our military effort at every conceivable angle. They compressed a vast continent, a hundred-million-souled nation, into a single community. They placed at the lips of the Chief Executive a trumpet through which he might call, on the instant, to the remotest citizen in the land. They gave to the voice of the Secretary of War a direct and immediate path to every camp and military chief in the country; to the voice of the Secretary of the Navy a medium for instant personal summons to his far-flung naval stations scattered over thousands of miles of coast line, and to his warships grimly ploughing the deep. They bound to a common direction and common purpose, with myriad threads of instant intercourse, the thousands of shops, mills, forges and factories fashioning the sinews of war. They built, almost overnight, at places that yesterday were desert wastes, complete telephone cities for the huge cantonments erected to house the newly created hosts of the National Army. They furiously multiplied and redoubled their efforts as they thinned their ranks by a constant outpouring of technically trained personnel into the Signal Corps, for administrative and front line duty, into the Navy, for special wire, radio and anti-submarine service, into a dozen other branches of military and naval activity. They helped to transplant to French soil a complete, American system of electrical communication, with modern devices of which Europe had scarcely dreamed. They advanced, under shell and machine-gun fire,

the swiftly moving strands of speech that linked the onrushing infantry to its base of command and supply. They bent the creative thought of their corps of a thousand highly trained inventors, to new and potent military devices—widening the range of wireless speech in the air, aiding the Navy to track the submarine, designing equipment for locating, by uncanny electrical creations, the direction of enemy gunfire, of hostile aircraft manœuvring in the dark.

All these efforts, unceasing, unstinted, shot through with the pure fire of American patriotism, furnish in their recital a drama of intense human interest, a source of pride and inspiration to every loyal American.

I am writing the story of the family, not of its household goods, for the same reason that you cannot describe the fruit, without describing the tree. The fruit is there *because* of the tree. Root, trunk, branch and twig, myriad leaf and shining blossom; running through it all, the life-giving sap: that is the story of the fruit.

The name of the family is the Bell Telephone System. There were other and smaller families, the so-called "Independent" telephone companies, whose men and women, both "over here" and "over there," rendered services that were magnificent and deserving of the highest praise. They have a story of their own to tell.

I propose to tell here the story of this single group of two hundred thousand Americans, because I believe it illustrates with peculiar aptness the story, in crystallised form, of the whole American nation in that supreme hour when it rose, as one man, above the level of petty and sordid things, above its mundane, bread-and-butter self, to a full and unsuspected revelation of its true majesty and grandeur.

PART I

FINGERS OF DESTINY

CIRCUITS OF VICTORY

CHAPTER I

TWO KINDS OF LEAVEN

I

THE ancient Greeks had a saying, "He whom the gods would destroy, they first make mad."

A half century ago, a mad German philosopher named Nietzsche gave birth to the following philosophy:

> Progress depends upon the survival of the fittest. The fittest are the strongest. What is strong, is right. What is weak, is wrong. The strong must therefore eliminate the weak. Any religion or morality which defends the weak against the strong, hinders progress, because it fosters weakness. Christianity is wrong: it is a religion of weakness, a feminine religion, protecting the weak. The highest aim of society is the development of the Strong Man, the Superman. We must, therefore, ruthlessly tear up by the roots any institution that hinders the development of the Superman.

Nietzsche died a madman. Well had it been for Germany, had his philosophy died with him.

But the seed fell on fertile soil. The philosophy of might evoked a ready response in the Prussian mind. Strength! That was the thing. War! Nothing worth while had ever come without it.

It was just the philosophy for a naturally warlike race.

From the earliest days, war had been the national industry of Prussia. As Napoleon observed, "Prussia seemed to be hatched from a cannon ball."

So the new Kultur became firmly entrenched: Nietzsche, its founder and philosopher; Bernhardi, its historian; the Kaiser, its High Priest; Hindenburg, Bissing and Ludendorff, its executioners. The army was all; the sword, sovereign. Other countries, it is true, possessed martial leaders; in Prussia, martial leaders possessed the country.

Now, the fundamental principle of an army is that authority must come from the top, down. Apply this to a whole nation, and you have the history of Prussianism. First, of course, came Gott. Then came His agent, the Kaiser, ruling by Divine Right. After him came his chieftains, that vast military aristocracy in whom was embodied the supreme law of the land. Parliaments there were, of course, and civilian bodies of government; but their real function was prescribed in one of the Kaiser's speeches: "It is the soldier and the army and not the majorities and Parliamentary decisions, that have forged the unity of the German Empire. It is on the army that my confidence rests." Hence if a Prussian soldier pushed a civilian off the sidewalk, there was no redress. If a stripling of a lieutenant cut down a lame civilian shoemaker with his sword, as at Zabern, he escaped unpunished.

And just as the political structure of Prussia was modeled along army lines, so her industrial structure was reared and educated to serve as the hand-maiden of militarism. The railroads were taken over by the Government, expanded and developed along strategic lines. The same principle was applied to telegraph and telephone systems. Under government direction, a chemical plant was established here,

a dye factory there, new industries were carefully fostered and protected by financial assistance from imperial bankers, —the entire industrial fabric was woven into a mesh of State Socialism, and carefully stitched to the Prussian uniform.

Equality was unknown. You were either looking up, to take orders, or looking down, to give them. Orders were to be accepted and obeyed, unquestioningly. Those on high would do the necessary thinking. Those below were to render the necessary obedience. This would develop unity. Unity would develop strength. Strength would develop conquest. Conquest would permit Kultur.

The result was a huge Man-Machine, without soul, whose name was Efficiency. Forged of iron discipline and unquestioning obedience, riveted together with perfect mechanical precision, it presented the most formidable contrivance of force the world had ever known.

Into this system the Prussian babe was born. In it he was reared and confirmed. For it he was willing to die.

Such was the leaven of autocracy, the doctrine of force, the religion of ruthless efficiency, which was to work and spread, doomed by its own philosophy to a final day of reckoning when it would either conquer the world or be crushed by it.

II

Elsewhere, also, something over a half century ago, a new birth of nationalism took place. A costly civil war had torn a nation into two bleeding pieces, which four years of struggle had re-united, leaving wounds fresh and crying to be healed. A Union had been saved, but a new America had to be created.

From the nation's birth, there had been a common tongue and a common tradition. But the country had grown to such geographical proportions, that many wondered if it could feasibly be held together. In 1843, when the Oregon Bill was under discussion in the United States Senate, leading senators declared that we could never have any interest in a country so remote. "Why," declared one senator, "it would require ten months for the representatives of that far-away land to come to the National Capital and get back home again. We can never have any interest in a country so remote, so difficult to reach, and so difficult to communicate with."

Gulfs of territorial distance presented seemingly impassable barriers of isolation. Isolation, as ever, had bred misunderstanding and dissension. A true union would never be possible, unless new means should be found to bridge the vast gaps of distance separating east and west, north and south. New channels of communication must be opened, to bring more closely together a nation spread over three million square miles of city, town and country, mountain, valley and plain. The urban dweller steeped in his daily round, the distant villager plodding his deliberate duties, the woodsman in his cabin, the farmer in his remote rurality,—these children of a common tradition had to be cemented into something more than a mere aggregation of people speaking a common language.

For the fates had decreed a test of the ages, a titanic trial of strength between the brute force of autocracy and the spiritual strength of democracy; and upon the outcome of that struggle the future of civilisation was to depend.

With boundless energy and giant enterprise, with all the vision and initiative of a free people, America took to the

task. Progress from the bottom up—that was the guiding principle. Salvation through self-reliance—that was the ruling method.

And just as in government, authority came from the people themselves, so in the tremendous burst of new economic life that followed, the streams of unification flowed from the wells of individual endeavour.

The epoch opened with an unprecedented expansion in railroad lines. Bands of steel projected new lines of intercourse from the Atlantic to the Pacific, from Canada to the Gulf. Telegraphy kept pace with the railroads, multiplying its numerous wires in every direction. And then, in 1875, just a decade after the close of the Civil War, a new era dawned in the history of modern America.

It came unheralded. The tide of events swept by as usual, scarcely giving more than a passing notice to the newcomer.

In an obscure attic in Boston, a professor of elocution named Alexander Graham Bell had invented—so, at least, he claimed—a "talking wire." It was probably some kind of "fake." He claimed it was possible to talk into a metal contraption, and be heard, through a wire, several miles distant.

It was not possible; but it was done. Skepticism finally had to give way. Public demonstrations, culminating in the historic exhibition before the world-famous scientists at the Philadelphia Centennial, established beyond peradventure the actuality of this new scientific wonder.

Very well, then, here was a wonderful thing; but what of it? What good was it, except to attract wonder at public exhibitions? When the normal Nine Days of Wonder had

passed, when the novelty had worn off, what would be left, save a mere "scientific toy"?

The verdict of the world was unanimous: "It is an interesting instrument for professors of electricity and acoustics; but it can never be a practical necessity." Capitalists admired; but when it came to investing, they fought shy.

There was only one thing which could take this electrical curiosity and transform it into an adjunct of civilisation. That thing was faith; absolute, unbounded, almost fanatical faith; faith strong enough to cut through the cake of conservatism and kindle enthusiasm where it would do the most good; faith coupled with vision, and supported by that singleness of purpose and sound business judgment which lie at the basis of every great commercial endeavor.

Step back, if you please, four decades into the past, and conceive, if you can, how utterly absurd Bell must have sounded when, reading a paper on "the future of the telephone," in 1878, he drew forth the following picture from his mental image: "It is conceivable that cables of telephone wires could be laid underground or suspended overhead, connecting up by branch wires private dwellings, country houses, shops, manufacturing establishments, etc., and also connecting cities and towns and various places throughout the country."

Nothing absurd about that, we say. No! *Not to-day.* But to get the modern equivalent for the impression created in the public mind of 1878 when Bell unfolded that dream, imagine some professor of to-day proposing to organise a company for the establishment of a commercial signalling system between the Earth and Mars, with long distance connections to Mercury, Venus, Neptune and Saturn!

Dreams are cheap. Anybody can have them, merely for

the dreaming. Most dreams never pass the dream stage. It is only when dreams are grounded in the practical, and backed by infinite courage and patience, that they may be transformed into real servitors of mankind.

"I am aware," said Bell, "that such ideas may appear to you Utopian and out of place, but, believing as I do that such a scheme will be the ultimate result of the introduction of the telephone to the public, I impress upon you the advisability of keeping this end in view that all present arrangements may be ultimately realised in *this grand system.*"

The day of the prophet is supposed to have passed. Yet I doubt if anywhere in the annals of man we can find an utterance more singularly prophetic than these words of Bell, spoken in 1876:

"Some day, all the people of the United States will sing the Star Spangled Banner in unison by means of the telephone."

"Will sing the Star Spangled Banner in unison." Did Bell, in one of those rare moments vouchsafed the seer, have a glimmering of that day to come when the grand chorus of democracy would lift and swell across the land and over the waters, until its mighty melody had drowned the strident discords of a madman's Hymn of Hate?

CHAPTER II

THE LEAVEN WORKS

I

STEADILY, surely, inexorably, the leaven of autocracy was at work.

"Progress through Conquest" was the master motif. Everything that Prussia had, she had acquired by force.

In 1864, with one stroke of her sword, she had, with the aid of Austria, detached Schleswig-Holstein from Denmark. The division of these spoils she used as an excuse for picking a quarrel with Austria. Within three weeks after the breaking off of diplomatic relations, the war with Austria was practically over. Austrian ascendancy was at an end, the North German states were annexed, and Prussia had won her right to do with Germany as she pleased.

France came next. In 1870, Bismarck succeeded, by a trick, in provoking a quarrel with Napoleon III. The Prussian legions hastened across the Rhine. Within seven weeks after the opening of hostilities, two French armies were defeated and captured, and the French Emperor himself made a prisoner in the débâcle of Sedan. Paris was taken, France humbled in the dust, and Alsace-Lorraine became German territory. In the same act, the South German states had joined the North German Federation, and the final unification of Germany under Prussia became established.

Bismarck was now for letting well enough alone for the time being; building up a new Germany by internal economic measures, turning his back upon colonial expansion, and keeping his enemies apart by tricks of the diplomatic trade.

But in 1888, William II became Emperor of Germany, and promptly dropped his pilot. His ideas on Germany were different from those of the Iron Chancellor. Germany was entitled to "a place in the sun," and she was going to get it.

Why, here was a new Germany, the most powerful nation on the European continent. Should she alone, of the great nations, be without her colonies, without lands to which Germany could carry her language and her national faith, without her own markets for German manufactures, without plantations on which could be grown the raw materials needed by her industry? Perish the thought! And the Kaiser bided his opportunity.

With characteristic thoroughness, Germany began to extend her "spheres of influence." As to the outside world, Germany and Austria became one, Germany being the one. In 1898, the Hohenzollern king of Bulgaria ceded direct railroad communication through his territories from Berlin and Vienna to Constantinople. In the following year, the Kaiser visited the Sultan of Turkey, and with a great show of pomp, professed his benign friendship for the Turk. With the Kaiser was a German company, which secured a concession for the construction of a railway across Asia Minor, Armenia and the fertile valleys of the Tigris and Euphrates, to Bagdad, and the head of the Persian Gulf. A few years later, the German militarization of Turkey began. It was to come in handy for the Kaiser.

So far, so good.

But as to the colonies, alas!—in Africa, South America and elsewhere—Germany seemed to have fallen hopelessly behind. Something must be done.

An opportunity presented itself at the close of the Spanish-American War. Dewey was at Manila. Prussia's mouth began to water, as she turned her thoughts toward the expiring colonial empire of Spain. Could not the American Admiral be frustrated? Germany turned to the British commander for support in this noble venture. She was met with a point-blank refusal. And the United States acquired the Philippines, paying in honest American dollars for what she might have had—and Germany wanted to get—by conquest.

War became more than ever a necessity to Prussia. It must be provoked, somehow. But how—and when?

In 1905, Germany thought she saw a chance in Morocco, which had been recognised as subject to French control. Russia, ally of France, had been defeated by the Japanese at Mukden. Her prestige and military reputation were under a cloud. France seemed to stand alone, except for Britain, and it did not seem likely that Britain would come to the aid of France. Accordingly, the Kaiser suddenly landed at Tangier, in Morocco, and proclaimed the integrity of Morocco.

The Kaiser's sword was drawn and ready. He demanded that the Moroccan question should be submitted to a council of nations.

France refused. War seemed certain.

In the end, the French ministry, weak and terrified, yielded. The council of nations was called, with the result that Britain backed France to the limit, Italy drew away coldly from her German ally, French authority in Morocco

received the seal of European approval, and the Kaiser was deprived of his war.

The Balkan situation seemed much more favourable to the Kaiser's "place in the sun." Ferdinand of Bulgaria was a German by birth. The wife of King Constantine of Greece was the Kaiser's sister. On the Roumanian throne sat a Hohenzollern King. But Serbia, Russia's protégé, was unfriendly. Serbia must be shown. There were 2,000,000 Serbs in the provinces of Bosnia and Herzegovina. In 1908 Austria, seizing a favourable opportunity, "annexed" these two provinces.

Once more the Kaiser thrust his sword into the balance. Once more the governments of Paris, London and St. Petersburg had to decide between war and surrender.

But Paris and London were not overenthusiastic, and St. Petersburg was still suffering from her Japanese defeats.

And so, once more, war was averted. But the Kaiser had enlarged his "place in the sun."

The next chance came in 1911. French troops had gone to Fez, in Morocco, to suppress an uprising. The Kaiser promptly sent a warship to Agadir, off the Moroccan coast, thus serving notice upon France and the rest of Europe that he proposed to share in the Moroccan estate.

Again, war threatened. But again, Britain backed France to the limit. And the Kaiser paused. Was this a favourable moment? It did not seem so. The Moroccan dispute was settled by mutual cessions of territory in Central Africa. France lost a hundred thousand square miles of Congo swamp, but acquired unquestioned title to Morocco.

And Germany fumed. The Kaiser was accused of surrendering to Britain. What was he waiting for, anyway? What was he afraid of? Did not Prussia possess the might-

iest army the world had ever known? Was she not equipped with super-cannon before which the stoutest forts must crumble like so much lathe, with redoubtable Zeppelins that would strike terror and destruction into the heart of Britain, with flame throwers, poison gas, and a thousand other infernal devices before which no nation could stand in a test of arms? Never in his reign had the Kaiser known such a storm of unpopularity. It was plain that never again must the Kaiser allow a peaceful settlement to thwart the destiny of the chosen people.

Bernhardi became the prophet of the times. In his "Germany and the Next War," which appeared in 1912 and ran through five editions before the year was out, he voiced in no uncertain terms the sentiment of the German people: "War is the father of all things. The sages of antiquity long before Darwin recognised this. The struggle for existence is, in the life of nature, the best of all healthy development. All existing things show themselves to be the result of contesting forces. So, in the life of man, the struggle is not merely the destructive, but the life-giving principle. . . . War gives a biologically just decision. . . . It is not only a biological law, but a moral obligation and as such an indispensable factor in civilisation." And again: "Our next war will be fought for the highest interests of our country and of mankind. This will invest it with importance in the world's history. 'World war or downfall!' will be our rallying cry."

The very next year, Germany astounded Europe by an army bill raising the peace footing of the Empire from 656,000 to 870,000, and by increasing her military expenditures to nearly a billion marks. "Der Tag" was clearly approaching.

And what time could be more favourable than the present?

France was degenerate, and could be crushed in an instant. Britain had her hands full with the Irish rebellion, and would most certainly be neutral; or, even if she went to war, she had no army, and could not possibly raise one before it was too late. Russian workingmen were agitating as they had never agitated before, and if Russia went to war, a revolution would paralyse her. Italy, at the worst, would remain neutral, and would probably join the Central Powers in time to climb into the victorious bandwagon. The Kiel Canal—this was in June, 1914—had been greatly improved, enabling the largest warships of the superb German navy to pass freely from the Baltic to the North Sea. The submarine had been developed and adapted to warfare by the German navy, to an extent not even remotely conjectured by the outside world.

Now was the time. Only an excuse was lacking.

The excuse came, more quickly than most people expected; and it was such a perfect pretext, that the Kaiser could not have wished for a better.

On June 29, 1914, newspaper headlines announced that on the previous day, the Archduke Franz Ferdinand, heir to the Austrian throne, had been assassinated in Serajevo, the capital of the Austrian province of Bosnia.

For a day or two the murder was matter for current comment. Then the news about it shrank to inside columns and gradually faded from the newspapers altogether. The murderer had been apprehended; doubtless he would receive the usual punishment meted out to assassins. Ere July was half spent, the crime had been almost forgotten.

Suddenly, the world was astounded by an amazing ultimatum from Austria to Serbia, blaming her for the assassi-

nation, imposing upon her ten humiliating demands, and calling virtually for a surrender of Serbian sovereignty. The demands were served on July 23d, with a time limit of forty-eight hours. They were followed up, on the next day, by a warning from Germany to the Entente Powers not to interfere.

Russia, bound to the serbs by race and religion, pledged to safeguard Serbian independence, begged Austria to extend her time limit, "to prevent incalculable and fatal consequences." Britain and France joined in the request.

Would Austria yield? Would the great Prussian combination miss this golden opportunity? Austria refused to extend the time limit by the fraction of a second.

Promptly within the time allotted, Serbia replied to Austria. She agreed to meet the Austrian demands in every humiliating detail, save that involving her sovereignty. As to that, she was willing to submit to a council of the Powers.

Without delay, Austria broke off diplomatic relations, and on July 28th, declared war upon Serbia.

In a final effort to postpone the inevitable, Russia proposed that Austria withdraw from her ultimatum the points involving Serbian sovereignty. Britain passed the proposal on to Germany, praying her to call off Austria. Germany replied, "Not till Austria had occupied Belgrade and the Serbian territory on the border."

Russia accepted the challenge and mobilised. Germany promptly demanded that Russia demobilise within twelve hours. Russia refused, and Germany declared war.

In the meantime, on July 25th, three days before Austria declared war upon Serbia, Germany had begun quietly moving troops to the French frontier, strengthening barbed wire entanglements, cutting down trees and occupying railway

stations where, in a few days, she had eight army corps ready for action. On August 2d she invaded Luxemburg, and on the same day, on the flimsy pretext that French aviators had bombed an unprotected German town, she invaded France. Then, on August 3d, she committed the crime of the ages, and invaded Belgium.

The situation was clear, and France declared a state of war with Germany.

Britain demanded that Germany respect Belgian neutrality. Germany, scoffing at "the scrap of paper," refused; and——

The war was on.

Step by step, Prussia had followed her destiny. Leg over leg, the dog had gone to Dover. "Der Tag" had arrived. The hour had struck.

II

What, in the meantime, had become of Bell's dream?

In 1876, the entire telephone system of the country consisted of two grotesque looking instruments, connected by 200 feet of wire, through which you could hear, amidst a confusion of cackling, squealing, moaning, shrieking and sibilant hissing, faint but unmistakable snatches of the human voice.

There were only two "users" in the entire system: Bell, who did the talking, and Watson, his assistant, who did the listening.

It was upon this crude base that Bell erected his wonderful dream of the future, a future in which still lay the unsolved mysteries of the transmitter, the switchboard, hard-drawn copper wire, transposed and metallic circuit, overhead

and underground cable, and the tens of thousands of telephone parts without which the dream of an America united by the telephone must ever have remained a dream.

There followed a few years of lectures and public demonstrations, of heroic effort to put the "toy" on the market, of disheartening attempts to enlist the aid of indifferent investors.

It was not until the Western Union Telegraph Company, which was then an imposing organisation with a capital stock of forty million dollars, attempted to overwhelm the small band of telephone enthusiasts by invading the field with an instrument of its own, that the investing public took any notice at all of the business possibilities of the telephone. In the very act of attempting to wipe the new enterprise out of existence, the Western Union gave it that recognition in the financial world that it needed to get a start.

People now began actually paying money for the privilege of leasing the telephone. Men stood in line to ask for agencies. Demands came from different parts of the country for a tentative trial of this new instrument of communication. The "toy" began to develop into a business.

But the enterprise was far from being established. It was launched, but on the roughest of seas. The little telephone company was taking in money from a small number of telephone users, but far from enough to yield a net profit, establish credit, or provide the basis for comprehensive expansion. The bulk of the public officials and business men were still hostile or skeptical. Bell and his associates had frequently to borrow their lunch money or go without eating. To add to their troubles, the Western Union had invaded the field with a superior transmitter, backed by virtually unlimited capital, by an army of agents and a network of wires spread

over the entire country, by an organisation determined to nip in the bud this new service that seemed to threaten competition. It became apparent that unless some extraordinary type of business executive could be found, a man with broad experience, abundant initiative, unquestioned courage and no small amount of faith, the telephone enterprise would be choked in its very infancy.

It was at this juncture that Theodore N. Vail came upon the scene. In the chain of telephone destiny stretching from its invention to the point where it completely transformed our national mode of existence, Vail was the connecting link.

It is doubtful whether there was another man in the country who could have fitted into the requirements of the situation as completely and nicely as did Vail; for while his faith in the future of the telephone was as firm, his vision as broad, as Bell's, he brought to bear upon this faith and this vision a rare combination of energy, aggressiveness and grasp of business detail, without which the history of America might well have presented an altered course.

Vail was at the time in the Railway Mail Service. It was a government job, but Vail had taken it seriously,—so seriously, in fact, that he had completely revolutionised it by introducing the bag system of postal cars and waging an everlasting warfare on waste and inefficiency. At the age of thirty, he found himself at the head of the service, charged with the supervision of some 3500 employees, and possessing a perfect picture of the routes of transportation and communication reaching every city, town and way station in the country.

About this time, "Uncle Joe" Cannon, then a young member of Congress, was approached with a proposition for investing $1000.00 in the new telephone project. He had

just lost a few hundred dollars in a scheme to convert brass into gold by a new chemical process. So he laughed heartily, slapped his thigh, and replied, "No, thanks. If I'm going to get 'stung' again, I'll invest in a couple of beehives."

A few days later, he called at the office of the Railway Mail Service to see Vail.

"Mr. Vail is not in," he was informed. "He has resigned his place."

"Resigned his place!" exclaimed Cannon. He was amazed. To resign a government position was almost unheard of.

"Yes, he's gone with this thing invented by Professor Bell. You know—they claim they can talk through a wire. Vail has invested some money in it, and he is going to make it his business."

"Well, it's just too bad," said Cannon. "I always liked Vail. They tried to get me for a sucker. I'm sorry it should have been a nice chap like Vail."

Such, however, was Vail's confidence in the future of the telephone, that he was willing, as he expressed it, "to leave a Government job with a small salary for a telephone job with no salary."

"My faith in the success of the enterprise," he wrote, in accepting the position of General Manager of the pioneer concern, "is such that I am willing to trust to it, and I have confidence that we shall establish the harmony and co-operation that is essential to the success of an enterprise of this kind."

Vail entered the infant telephone enterprise with his whole heart and soul wrapped up in its development. He burned his bridges behind him, and never again looked back. Henceforth, his eyes were toward a definite future. That future concerned the destiny of the telephone. It took shape



THEODORE N. VAIL

Exponent of national unification by means of multiplying the channels of communication through "one system, with a common policy, common purpose and common action; comprehensive, universal, interdependent, inter-communicating; like a highway system of the country, extending from every door to every other door; affording electrical communication of every kind from every one at every place to every one at every other place." Vail's idea on unification represents the diametrical opposite of the doctrine preached by Bernhardi and the pan-Germanists, which was that of progress and unification through conquest.


CANADA
PACIFIC OCEAN
ATLANTIC OCEAN
SEATTLE
PORTLAND
HELENA
BISMARCK
BOISÉ CITY
SALT LAKE CITY
SAN FRANCISCO
LOS ANGELES
SANTA FE
TUCSON
EL PASO
MEXICO
Chicago to San Francisco 2290 miles
GERMANY
POLAND
AUSTRIA-HUNGARY
RUMANIA
BULGARIA
TURKEY
Constantinople
CHICAGO
New York to Chicago 910 miles
INDIANAPOLIS
CINCINNATI
ST LOUIS
LOUISVILLE
DETROIT
CLEVELAND
PITTSBURGH
BUFFALO
BOSTON
PROVIDENCE
NEW YORK
PHILADELPHIA
BALTIMORE
WASHINGTON
ATLANTIC CITY
ATLANTA
CHARLESTON
SAVANNAH
NEW ORLEANS
GALVESTON
GULF OF MEXICO
BAHAMA
LAKE SUPERIOR
LAKE MICHIGAN
LAKE ERIE
Lake Ontario
River St. Lawrence
BALTIC SEA
BLACK SEA
ADRIATIC SEA
Trieste
Prague
Vienna
Budapest
Lemberg
Kovel
Riga
Libau
Danzig
Memel
Königsberg
Thorn
Posen
Breslau
Dresden
Berlin
Hamburg
Amsterdam
Rotterdam
Antwerp
Brussels
Metz
Strassburg
Basle
Munich
Innsbruck
Verona
Milan
Turin
Genoa
Marseilles
Lyons
Paris
Calais
Dover
London
Liverpool
Belfast
Dublin
Edinburgh
Glasgow
Aberdeen
Inverness
Stranraer
Holyhead
Fishguard
Plymouth
Portsmouth
Southampton
Cherbourg
Le Havre
Dieppe
Boulogne
Ostend
Flushing
Ghent
Lille
Nancy
Belfort
Geneva
Lausanne
Zurich
Bern
Lucerne
Basel
Coblenz
Cologne
Aachen
Hanover
Bremen
Emden
Kiel
Stettin
Danzig
Warsaw
Cracow
Lemberg
Odessa
Sebastopol
Constantinople
Smyrna
Salonica
Athens
Valetta
Malta
Gibraltar
Tangier
Algiers
Tunis
Bizerta
Oran
Marseilles
Genoa
Naples
Messina
Palermo
Brindisi
Ancona
Venice
Trieste
Fiume
Pola
Zara
Cattaro
Durazzo
Valona
Corfu
Patras
Piraeus
Volo
Salonica
Dedeagatch
Rustchuk
Varna
Bucharest
Galatz
Ismail
Reni
Kishinev
Jassy
Czernowitz
Stanislau
Kolomea
Stryj
Lemberg
Przemysl
Jaroslau
Tarnow
Cracow
Oswiecim
Teschen
Ostrau
Prerau
Olmütz
Brünn
Iglau
Znaim
Vienna
Linz
Salzburg
Innsbruck
Bregenz
Feldkirch
Chur
Zurich
Basle
Strassburg
Nancy
Metz
Thionville
Longwy
Sedan
Rethel
Laon
Soissons
Compiègne
Amiens
Abbeville
Boulogne
Calais
Dunkirk
Ostend
Bruges
Ghent
Antwerp
Brussels
Namur
Liège
Aachen
Cologne
Coblenz
Mainz
Mannheim
Karlsruhe
Stuttgart
Ulm
Augsburg
Munich
Regensburg
Passau
Linz
Vienna
Budapest
Belgrade
Nish
Sofia
Philippopolis
Adrianople
Constantinople
Gallipoli
Dardanelles
Smyrna
Mytilene
Salonica
Athens
Patras
Corfu
Valona
Durazzo
Cattaro
Ragusa
Spalato
Zara
Pola
Fiume
Trieste
Venice
Ancona
Rome
Naples
Messina
Palermo
Syracuse
Malta
Valetta
Gibraltar
Tangier
Algiers
Tunis
Bizerta
Oran
Marseilles
Lyons
Geneva
Lausanne
Bern
Lucerne

in the following conception, as expressed in Vail's own words:

"One system, with a common policy, common purpose and common action; comprehensive, universal, inter-dependent, inter-communicating; like a highway system of the country, extending from every door to every other door; affording electrical communication of every kind from every one at every place to every one at every other place."

Bold language indeed, at a time when the extreme limit of making yourself heard over a wire was a few miles, when people continued to look at the telephone as a shady and uncertain venture, when the idea of talking from one city to another seemed the height of a visionary's folly. But it was Vail's confession of faith. It was a goal that he never for one moment lost sight of. It was to him, throughout the succeeding decades, "a pillar of cloud by day and a pillar of fire by night."

Never have we had a better exemplification of the old adage that "an institution is the lengthened shadow of a man." Step by step the goal was approached.

> A speck, a mist, a shape I wist!
> And still it neared and neared.

It grew from a dream to a possibility, from a possibility to a probability, from a probability to a fact.

The story in detail of how this goal was reached has been related elsewhere. There is neither space nor occasion for rehearsing it here. How Vail stiffened the backbone of the little Bell Telephone Company, discouraged all talk of surrender, and fought the imposing Western Union to a standstill and an ultimate triumph; how, by a continuous conquest over a thousand physical obstacles, by invention after invention, improvement after improvement, the crude device

for transmitting speech by wire was developed to a stage of perfection that commanded the admiration of the world; how the original switchboard was designed and created, and by scrapping and rebuilding, scrapping and rebuilding, was evolved into the modern multiple switchboard; how the unearthly sounds that coursed through the original "grounded" circuit and all but drowned out the human voice—the "spluttering and bubbling, shrieking and gasping, whistling and screaming, rustling of leaves, croaking of frogs, hissing of steam, flapping of birds' wings, clicks from telegraph wires, scraps of talk from other telephones and curious squeals unlike any known sound"—were banished by the institution of the "metallic" circuit; how means were found to bury the wires that obscured the light of day in crowded urban centres; how the "loading coil" was designed which extended the range of the human voice to distances otherwise impossible; how the "phantom circuit" was developed so that three telephone conversations could at one and the same time run along but two sets of wires; how the long distance telephone lines began to build up, from Boston to Providence, from Boston to New York, from New York to Philadelphia, from New York to Chicago, and from intervening cities and towns to one another; how, during the inauguration of President Taft in 1909, a raging blizzard, completely demoralising aerial cables leading to Washington, and isolating our national capital from the rest of the world, brought determination to Vail that never again should such a condition recur,—a determination that matured into an underground cable all the way from Washington to New York and Boston; how the long-distance telephone frontier was extended from Chicago to Denver, from Denver to Salt Lake City and from Salt Lake City to San Francisco,—all

this has been told elsewhere in complete and fascinating detail.

Back of it all lay the constant initiative and driving force of Vail's personality, actuated by that dream of a telephone-united America which never for an instant slipped from his vision.

As each new landmark in the memorable journey was reached, as each new triumph over nature was signalised, as each new invention and extension in service was announced to the public and received with unstinted admiration, the prompt answer came from Vail, "Every advance is simply an incident in the realisation of an ideal. We propose to move forward. One policy. One system. Universal service."

III

Two events, apparently unrelated, occurred on one and the same day.

On July 29, 1914, Austria invaded Serbia, and fired the opening guns of the great war of autocracy against democracy.

On July 29, 1914, Vail, sitting in his office in New York City, sent his voice 3400 miles across the country, and quietly conversed with the President of the Pacific Telephone and Telegraph Company, sitting in his office in San Francisco.

The dream of Nietzsche, the boast of Bernhardi, the proud march of Prussia toward world domination had come to a nead.

The dream of Bell, the slogan of Vail, the persistent pur-

pose of converting a continent into a community, had become a fact.

Unification of Germany from the top down had been virtually consummated, and was ready to work its purpose.

Unification of America from the bottom up had also been virtually consummated, and it, too, was ready to work its purpose.

IV

The establishment of the transcontinental telephone line was a final blow to sectionalism.

A great deal of idle talk has been wasted in discussing What Might Have Been. But can anyone doubt that had the telephone system as evolved in this country at the opening of the World War, existed prior to 1861, North and South could not possibly have drifted so far apart, the Civil War could not possibly have occurred?

And can anyone doubt that had the telephone system in this country not reached its present stage of development until some future date, the history of the World War might have been a different one indeed?

Could some angel of destiny have whispered into Vail's ear, back in those doubtful days when he took charge of the infant telephone enterprise, that in the year of our Lord One Thousand Nine Hundred and Seventeen, America would be involved in the bloodiest military maelstrom of history, that she would have to summon her strength and unite her resources in the quickest possible time in order that she might push the scales of fate in favor of democracy, Vail could not possibly have conceived his dream of telephone destiny more nicely, nor pushed it to a more timely realisation.

CHAPTER III

NEUTRALITY ON A TIGHTROPE

You remember, do you not, the late summer and fall of 1914?

Excitement ran high. Newsboys screamed their extras every hour. You followed, in a dazed sort of way, the progress of the mighty conflict. You devoured every bulletin and headline. You invested perchance, in a map of Europe, and stuck coloured pins into it. You had friends, tourists, caught in the confusion on the other side, returning home with harrowing details of desperate financial straits, of demoralised railway travel, of nightmare crossings in the steerage.

It all seemed so strange, so impossible. And it all came so fast. The Germans overran Belgium. The Germans overran France. The Germans were moving forward, ever forward; not a word about a German retreat. Now they were at Liège; now at Namur; now at Antwerp. They ploughed through the British in Flanders. They overwhelmed the Russians at Tannenberg. They pushed the whole French line backward in retreat to Nancy, to the Marne, to the very gates of Paris.

The Marne! It saved Paris. It killed German hope of a short war. It marked the beginning of a long deadlock.

Mighty had seemed the German onrush, but it had failed of its purpose. The plan had been to rush through Belgium, crush France before she could gather her wits, turn swiftly

upon Russia, put her out of the reckoning, and then—laugh in the face of Britain and the rest of the world.

"The best laid plans gang aft aglee." Little Belgium had amazed the world by her desperate resistance. She had maintained a heroic defense just long enough to give France the necessary breathing spell. Britain had mobilised a valiant vanguard almost overnight. The Hun horde had been stopped at the Marne. The gruelling conflict had only begun.

And America looked on—a spectator. The war was horrible; but it was remote. It could not reach our shores, thanks to our "splendid isolation." It was a strictly European quarrel, in which we had no part. Our neutrality was announced in a presidential proclamation defining our duties and our rights as neutrals.

But that the people of the United States should be really indifferent, was impossible. We could no more remain neutral in feeling, than we could govern our perceptions, control our senses, or prevent our interest from being intimately affected by the trend of events. Gradually the sense of the nation cleared. Except for that element of doubtful citizenship stigmatised by Theodore Roosevelt as "hyphenates," popular opinion in America began to draw to a definite focus. There was a growing perception of Germany's real significance and purpose in the conflict. Prussian history and politics began to be appraised at their true value. What had looked like a formless bogey, now held up its ugly talons in the full light of day. Every American possessing an innate sense of decency was shocked by the manner in which Prussia had precipitated the conflict; by the brutal way she had prosecuted it; by the invasion of Belgium, and the atrocities perpetrated on her helpless population; by the burning and sacking of Louvain, the wanton destruction of Rheims, the bar-

barous treatment of prisoners and civilian populations, the uncivilised use of poison gas, liquid fire, and other forbidden weapons of warfare; by that horrible path of murder, rapine, brutality and crime which marked the progress of the Prussian hordes.

Technically, America was neutral. But her moral sense revolted. And she combined this anomaly in the familiar if inelegant expression of the times: "We are strictly neutral; we don't give a damn who licks the Germans!"

As antidote to her nauseating series of misdeeds, in an effort to stem the rising tide of adverse American sentiment, Germany invaded America with a veritable flood of propaganda, bombarding every highway of publicity with the poison-gas of a carefully prepared literary offensive. Every possible base of attack was utilised: the press, the platform, the pulpit, the post-office—even the seats of learning.

No sane American was fooled for an instant. By the beginning of 1915, it was clear where America stood at heart.

So Prussia opened up with two new weapons of Kultur: an underground warfare of intriguing, bombing and dynamiting directed against munitions in America; and an underseas warfare of murder and piracy directed indiscriminately against men, women and children, combatant or non-combatant, neutral or foe.

The tightrope of neutrality became increasingly difficult to walk.

Several times during 1915, America seemed about to plunge into the maelstrom.

On February 28, 1915, the steamship *Frye* was sunk by German gunfire. On March 28, 1915, the steamship *Falaba* was sent to the bottom. And then, on May 7, 1915, the *Lusitania,* one of the fastest steamships of the Cunard line,

was sunk by two torpedoes from a German submarine. Eleven hundred and fifty-three human beings were sent to a watery grave, including one hundred and fourteen Americans, men, women and children.

News of the crime fell upon the world as an unbelievable thing. No pen can describe the horror and rage with which the American people first learned of this deliberately planned murder upon the high seas.

Germany promptly sent a note justifying the deed. America awaited breathlessly the reply that would come from Washington. The outraged conscience of a nation clamoured for expression.

There followed months of diplomatic notes and subsequent sinkings, the final upshot of which was a sudden change of German front, and the assurance that "liners will not be sunk by our submarines without warning and without safety to the lives of the non-combatants, provided the liners do not try to escape or offer resistance."

We had won a diplomatic victory! America breathed a sigh of relief. At last, Germany had been forced to yield to the dictates of humanity.

It was not known at the time that this sudden fit of humane feeling was based solely on the circumstance that forty-four German submarines had been captured by Great Britain, and some twenty-six others sunk.

By all means, it was now worth while to avert a possible break with the United States. The plan was to present a front of conciliation until such time as submarine frightfulness could be profitably resumed. In good time, an excuse would be found for taking up again the campaign of piracy and murder.

A twilight of diplomatic agreement ensued. The crisis

had been tided over. America was lulled into a sense of temporary security; somewhat uneasy, to be sure, but accompanied by just enough apathy to assure Germany that the American situation had been disposed of for the time being.

Not that it mattered a great deal to Germany. What harm could come from America? She was as unprepared as a babe. She was evidently determined to remain unprepared. She had vast resources in men and material, but how could she possibly get them together in time to count?

The experts of the German General Staff calculated the American factors with the precision of a calculagraph. They translated America into mathematical tables worked out to the last decimal. And—thanks to German method—they overlooked the fact that something may lie behind the last decimal, something that simply evades all rules of arithmetic. They fell afoul of their own system, precisely as they did with France, precisely as they did with Belgium, precisely as they did with England.

For America *was* preparing; unconsciously, perhaps, but none the less effectively.

The Prussian saw only the surface of America: he diagnosed the government; he counted heads; he estimated the army, the navy, rifles, guns, ships, money—surface. Beyond that, he saw nothing.

Had you told the Prussian military experts at the time that public sentiment in America was being mobilised, they would have laughed in your face. "Can you translate that into figures?" they would have asked.

That the spirit of a people dwelling on a continent three thousand miles in width, conglomerated of all the races of the world, had been slowly but surely fused to a white-heat of patriotism capable, on provocation, of blazing its way even

through a Hindenburg line,—such an idea was nothing short of arrant nonsense to a statistical High Command.

"These idiotic Yankees do not understand that effectiveness in war means years of preparation. Let them rage and froth. Before they can make any difference in the contest, we shall have won the war, and then we won't stand for any nonsense from the United States of America."

That America was a veritable bundle of electric nerves, connecting ten million cells of inter-communication, and that this fact had an important bearing on her capacity for mobilisation in emergency,—such a thought never even suggested itself!

I doubt if anything attracted less attention in Berlin, in the latter part of January, 1915, than the formal opening of the transcontinental telephone line, which took place on the 25th of that month.

On that historic occasion, Dr. Alexander Graham Bell talked through an exact duplicate of the first telephone which Thomas A. Watson had made for him in June, 1875. The same parties who were the first in the world to converse over a telephone, conversed again; not over a distance separating one room from another, as in 1875, but over 3400 miles of space. Again Bell repeated the first words spoken over the telephone, "Watson, come here, I want you." Forty years before, Watson had dashed madly back to Bell, exclaiming, "I heard you! I heard you!" This time he replied, "It will take me a week to get there."

The Panama-Pacific Exposition was being held at San Francisco. East was still East, and West was still West; but the twain had met! Mayor Mitchel, of New York City, and Mayor Rolfe, of San Francisco, exchanged greetings by

telephone as if they were talking together in the same room. Vail, at Jekyl Island, talked to New York and thence across the continent, making a distance of 4500 miles. President Wilson, sitting in the White House at Washington, sent his voice in congratulation to New York City and across the continent, little dreaming that before very long he would again be sending his voice across the selfsame path, on a mission not gala, but grim!

The man under whose immediate direction the telephone network had been built up to continental proportions, was destined to play a leading rôle in the stirring days to come: to serve as an important point of contact between the Army and the Bell System. This man was John J. Carty, then Chief Engineer of the American Telephone and Telegraph Company.

To detail Carty's record with the American Telephone and Telegraph Company would be to detail a large part of the phenomenal growth of the telephone art, just as to detail his record in the Great War would be to write a large part of Signal Corps history made by the Bell Telephone System. Carty had entered the great telephone game thirty-six years before, as a "boy operator." It was he who, three years later—a youth of twenty-two—introduced his pet idea of a "metallic circuit" on the new line from Boston to Providence, banishing as if by magic those fearful noises that inhabited the "grounded" line.

It would seem as if no great inventor or builder is free from prophetic moments. At the formal opening of the transcontinental telephone line, at a time when America did not even dream of going to war, Carty said to the distinguished guests assembled:

This is not a firing line, but in a way it is analogous to a firing line. It is not a firing line 350 miles long, but it is a line of peace 3400 miles long, east and west, and 1100 miles long, north and south, with 200 more to be added to-night, when there is to be a celebration in Boston.

There are about 1500 men scattered over this line, and from this room where temporary headquarters are established, all these men are co-ordinated. I think it is true that never before have men been co-ordinated over such a vast length of line from one point. We have men in the Sierras with snowshoes and men down in the southern land with automobiles and bicycles. We have men on the plains, in the bad lands, with mules, and others with saddle horses; and we have men on foot. There is no section of this vast land but what, if word is given here, a man will reach it inside of two hours, and in other sections it can be reached instantly. This morning, when I called up in a routine fashion, one of the men had gone off duty and another had come on. I wanted to know how things were going, and I got the temperature of almost every foot of that line. Sleet was forming in New Jersey three-quarters of an inch thick. In the neighbourhood of Pittsburg trouble was brewing. The Midland to Boston was out, but at three o'clock there were three men at work on it and it was fixed. Out in the Middle West there was trouble. I was, as it were, feeling the pulse of the organisation all over the line.

I wish that I could convey to you the enthusiasm, the ability, the faithfulness of the men and women working on this project to-day. It seems large. It is like a great manœuvre. It has taught much, it has taught us as much about our system as any manœuvre would teach an army. There is much for the army to learn here, because any one of those fifteen hundred men might have represented a colonel, or a commander of a brigade, or any other number of men. Battles are now fought by telephone; and, to be able to manage the telephone, to get the messages back and forth, to have a good understanding at the different ends of the line, and to be a good telephone operator, is now becoming a part of the duty of the commanding general.

The *United* States of America! New significance had been given to that name. Not only was California talking to New York, voice to voice, but state after state, connected up to the

new transcontinental passageway of instantaneous communication, became linked by new bonds of intercourse to every other state in the Union. Great national associations,—scientific, economic, engineering, literary, educational, business,—with thousands of members scattered from coast to coast, held their meetings by telephone, gathered at a dozen different cities all over the country, listened simultaneously to the chairman's address, communicated freely with one another, conducted their meetings as if assembled in the same hall; a motion made in New York, seconded in Pittsburgh, carried by vote taken at one and the same time, by one and the same impulse darting out and returning with the speed of thought over the thousands of miles of intervening space.

And so, throughout the year 1915, while the tightrope of neutrality grew more and more precarious, while the submarine issue rose and fell on the tide of Teutonic convenience, while America's immediate future lay in the lap of the gods, and the minds of her people filled with a vague misgiving; while the word "preparedness" began to be heard in many quarters and decried in many others, the telephone network continued to expand and round out, fulfilling the original dream of the Inventor and the original plan of the Builder.

In the bright lexicon of telephone experience, this word "preparedness" was not a new one. It was of the very essence of its growth. It explains, as nothing else can explain, the marvellous way in which a curious "toy" had grown, in barely forty years, to a system of universal, instantaneous intercommunication, embracing ten million telephones and twenty-five million miles of wire.

Before 1875, the country did not know it needed the telephone. Before 1878, the country did not know it needed universal telephone service. But Bell knew it, and Vail knew it, and they proceeded to furnish the facilities in advance of the public need.

It was so with every step in the upbuilding of the great system. Time and again, when lines were built to remote and obscure places, investors protested that the lines could not possibly be profitable for years to come. "Provide the facilities," answered Vail. "The demand must inevitably catch up."

When the line to Chicago was built, a prominent business man avowed that he wouldn't take it as a gift. When the transcontinental telephone line was completed, no one pretended that it would be profitable for years to come. But it meant universal service; and that, in its broadest sense, was profitable indeed!

It was this deliberate mapping out of a definite, advance policy, this laying of plans and spending of money, not for the day, nor for the morrow, but for the next five, ten and twenty years, that furnished the foundation stones for "preparedness," the means to meet with equal readiness the progressive demands of peace and the emergency demands of war.

By the year 1915, the vast total of sixty million dollars had come to represent the annual fund of preparedness regarded as necessary for adequately anticipating the telephone future.

While the public was still lost in wonderment and congratulation upon the successful completion of transcontinental telephony, Vail was quietly laying his plans for new and daring conquests of space, encouraging his organisation

by merited praise, and at the same time spurring them on to pastures new in the field of electrical communication. Years before, he had established a department of "development and research," consisting of a group of experts whose sole function it was to pierce the veil of the unknown by continuous study and experiment. With their minds forever dwelling in the filmy but enchanted realm of the future, with their feet planted on the firm soil of established science, this group had grown, under the immediate direction of Carty, into a unique body of over a thousand highly trained engineers and laboratory experts,—a corps of inventors, expert engineers, scientists, graduates and former professors of a hundred scientific institutions: toiling, experimenting, inventing, improving, with all the facilities of the Bell System at their command.

It was therefore no surprise to those on the inside of the organisation, much as it astonished the rest of the world, when close upon the heels of transcontinental telephony, it was announced on April 4, 1915, that speech had been successfully transmitted by wireless from a radio station at Montauk Point, Long Island, to Wilmington, Delaware.

The public had not yet got over its first gasp of astonishment at this amazing feat, when another announcement came along that on August 27, 1915, speech had been successfully transmitted through the air from Arlington, Va., to Darien on the Isthmus of Panama. By permission of the Navy Department, Bell engineers had installed their apparatus at the naval wireless stations at these points, and the human voice had been sent through 2100 miles of thin ether!

What next? The world ceased to marvel. Apparently nothing was impossible.

On September 30, 1915, wireless telephone communication was established between Arlington, Va., and Pearl Harbor, in the Hawaiian Islands.

"Hello, Hawaii" meant that 4900 miles of ethereal space had been bridged by the human voice, or more than twice the distance between Arlington and the Isthmus.



SECRETARY OF THE NAVY DANIELS

speaking by wire and wireless telephone to Captain Lloyd H. Chandler on board the U. S. S. *New Hampshire* out at sea.



Inset photo © Underwood & Underwood

SOME OF THE GUESTS AT THE SPEAKER'S TABLE

During the noteworthy dinner of the National Geographic Society, held in Washington on the evening of March 7, 1916, when El Paso was connected up by telephone with Washington, and Colonel John J. Carty conveyed the compliments of the Acting Secretary of War to General John J. Pershing, down on the Mexican border. (Inset) General John J. Pershing seated in front of his tent at his headquarters as he appeared at the time the historic telephone conversation took place between Washington and El Paso

CHAPTER IV

COMING EVENTS CAST THEIR SHADOWS

I

October, 1915.

In the still watches of the night, perched atop the Eiffel Tower 1000 feet above Paris, with his ear glued to a receiver of peculiar design, a Bell engineer named Shreeve sat patiently awaiting the result of an experiment.

Below him slumbered the city of tragedy and sacrifice. Off in the distance, the flash of guns on the firing line was plainly visible.

Out of the black void came a human voice. It was the voice for which Shreeve had been listening. A voice from another world—a world of peace and plenty—a world that knew not this horror of suffering and sacrifice going on immediately about the strange listener in the tower. It was the voice of a brother engineer which was at that moment being sent through the air from Arlington to Hawaii, away off in the Western Hemisphere. Moved by a human breath, this voice had travelled all the way across the waters of the Atlantic, and here it was—an instant after it started—in the very centre of the great European conflict!

You remember the event, of course. But did it occur to you, at the time you read it, that it furnished two notable straws to show which way the wind blew?



WHERE THE BELL WIRELESS TELEPHONE HAD REACHED UP TO OUR ENTRY INTO THE WORLD WAR

The main circle shows the territory within a radius from Washington to 4900 miles, the distance from Washington to Honolulu, which was reached by a Bell wireless telephone message, September 29, 1915. The same message could have been heard at a properly equipped radio tower at any point within the circle. The dotted circle of equal radius shows that a telephone message from a wireless station at Seattle could be heard at Yokohama. Paris was reached October 21, 1915, and the message was heard simultaneously at Honolulu.

France was at the time fighting for her life. She was asked to permit representatives of a neutral nation, whose ultimate position in the war she could by no means foretell, to set up apparatus in her most powerful and vitally needed wireless station, for the purpose of conducting experiments in which at the time she could not possibly have any great interest.

She complied with the request.

And here is the other straw.

"There is one thing about these experiments," said Carty six months after that memorable first voyage of the voice

across the Atlantic (we were still neutral), "that is most gratifying. It was essential, for reasons that cannot be stated now, that these experiments should be kept secret. There was good reason to believe that if it were known that we were carrying them on, owing to war conditions, there would probably have been obstacles placed in our way that would absolutely have prevented our going on. I cannot describe what these obstacles would be, but they were real. So it was necessary that they should be kept secret, and at the same time it was necessary that a large number in our Bell System should know the secret. For six months telephone operators and telephone engineers by the hundreds knew all about it, it was a matter of most sensational import, but not one word leaked out."

It was not from the direction of France that it was feared "obstacles would be placed in our way."

II

On the evening of March 7, 1916, John J. Pershing, Brigadier-General in the United States Army, stationed down on the Mexican border, received a startling message.

"Washington calling you on the telephone!" he was informed.

"On the *telephone?*" he asked in wonderment. Washington and El Paso had never been connected by telephone before.

"Yes, sir. The National Geographic Society is holding its annual dinner in Washington to-night, and they're giving an exhibition of transcontinental telephony. El Paso has just been connected up."

Pershing promptly picked up the receiver. A voice clear and distinct, came over the wires:

"Hello, General Pershing. This is Mr. Carty."

"Hello, Mr. Carty!"

"General Scott wishes to send his compliments, and to ask, how is everything on the border?"

"All's quiet on the border."

"Did you realise you were talking with 800 people?" As a matter of fact, every member and guest present at the dinner had a receiver to his ear, and was listening in.

"No, I did not," answered General Pershing. "If I had known it, I might have thought of something worth while to say."

"Anything you say, General, I am sure the National Geographic Society will consider worth while."

Thus called upon, the General rose to the occasion and delivered his after dinner speech to the assembled diners.

"My greetings to the National Geographic Society. I have attended some of its great dinners and know what impressive functions they are. I am a member of the Society and esteem it a rare privilege to help further its splendid work."

A peculiar trick of fate, this two-thousand-mile greeting. It was the first of three notable meetings between these two men.

Add two years and a half in point of time, subtract the sandy shore of the Rio Grande and substitute the war devastated terrain of France. The two have met again. All is *not* "quiet on the border." It is during the very height of the Meuse-Argonne offensive, destined to break the backbone of the Prussian Army. Pershing has "something worth while to say." He is describing to Carty the progress of the attack, and the concentration of new enemy forces.

Drop the curtain—this time for a period of six months. No Man's Land is no more. The Prussian host has dispersed. The meeting takes place at Chaumont, General Headquarters of the A. E. F.

The object of the meeting is the awarding of a Distinguished Service Medal.

The bestower thereof is General John J. Pershing, Commander-in-Chief of the American Expeditionary Forces.

The recipient is Colonel John J. Carty, chief of signal arrangements for the American Commission to Negotiate Peace.

III

For more reasons than one, that dinner of the National Geographic Society was memorable.

Present at this dinner, and sitting at Carty's right, was Major-General Hugh L. Scott, Chief of Staff of the United States Army, and acting as Secretary of War *ad interim* (Secretary Garrison had resigned shortly before and Secretary Baker had not yet taken office.) The General said very little at the dinner. But he did some hard thinking. He saw at a glance the tremendous war possibilities opened up by this remarkable demonstration of the range of the human voice. He noted how, in the twinkling of an eye, it had swept from sea to sea, had travelled from that dinner table to Pittsburgh, to Chicago, to Omaha, to Denver, to Salt Lake City, to Seattle, to San Francisco; had reached down to the Mexican border and picked up a greeting and a direct report from the chief of the American forces two thousand miles away; had travelled in a straight, southerly direction to Jacksonville, Florida; in a northerly direction to Ottawa, Canada;

had brought New York, Buffalo and Boston into the very midst of these diners.

And the General tucked these impressions away into the military folds of his brain for reference at no very distant future.

Present also at this meeting was Secretary of the Navy Daniels. Upon him, too, the military and naval possibilities revealed by this stupendous performance of the telephone were not lost.

A month later, Secretary Daniels wrote to President Vail, of the American Telephone and Telegraph Company, "appealing to the patriotic sense of this Company," and asking whether it was in a position "to give the Department a demonstration of what could be accomplished in the way of communication, particularly in long distance telephony and telegraphy, which would bring the offices of the Department and the Navy Yards and Stations within the limits of the United States proper into that close touch which the exigencies of war might demand.

"In order that this mobilisation of forces of communication may be complete," he added, "and recalling the close co-operation of your Company in the development of the wireless telephone, it is confidently hoped that its use as a means of communication with a ship at sea could also be demonstrated at the same time under such conditions that might be mutually agreed upon."

Of course—the Secretary of the Navy reminded Vail—"Congress provides no funds whereby the expense of such a demonstration could be borne by the Government and thereby recognises that whatever is done by your Company will have to be free of all expense to the Department."

Vail did not hesitate.

"We will gladly furnish the demonstration desired," was his prompt response, "in such a way and at such times as may be arranged upon between the proper officials of the Government and of this Company."

At four o'clock on the afternoon of May 6, 1916, war was declared—theoretically. For forty hours the Naval Bureau of Communication was conducted on a strictly war basis.

"An enemy fleet was approaching the Atlantic coast." The defending fleet was represented by the battleship *New Hampshire,* which was to be manœuvred under orders direct from Washington. Constant communication was to be maintained between the sea force and the Board of Strategy at the Navy Department.

Sixteen of the government naval stations, scattered along the borders of the nation, from Maine to California and from the Great Lakes to the Gulf of Mexico, were to be brought into instant voice communication with headquarters at Washington.

The test came off without a hitch. With uncanny ease and speed, the Secretary of the Navy, sitting at his desk in Washington, shifted his voice from the Atlantic to the Pacific, from the Pacific to the Great Lakes, from the Great Lakes to the Gulf.

One minute Secretary Daniels was conversing with the Commandant of the Brooklyn Navy Yard, and the next minute he was talking with the Commandant of the Naval Station at San Diego, California.

Within four minutes, instructions were dispatched from Washington to San Diego by telephone, and thence via Point Loma to the cruiser *Raleigh,* down in Central American waters at Corinto, Nicaragua.

It took but 28 seconds to make the telephone connection

between Secretary Daniels' office and the Naval Station at San Diego. In 27 seconds the Brooklyn Navy Yard was connected with Washington. In 36 seconds Washington was in telephone touch with the Great Lakes, Illinois, Naval Station. In 41 seconds, the Secretary of the Navy was talking with the Commandant of the Norfolk Navy Yard.

On the afternoon of May 6th, Captain Chandler was at his station on the bridge of the U. S. S. *New Hampshire* lying just outside of Hampton Roads.

Promptly at 4:00 p. m. Secretary Daniels in Washington lifted the receiver of the telephone on his desk, and asked to be connected with Captain Chandler—much as he might have asked to be connected with one of his subordinates in the same building. Without delay the connection was made.

"Take this order. Get under way this afternoon, stand out to sea and report your position to me by wireless telephone every hour."

"The *New Hampshire* will not be able to get under way before 10:00 o'clock to-morrow morning, sir," replied Captain Chandler.

Rear Admiral Benson, Chief of Naval Operations, stepped to the telephone and conveyed the official order to Captain Chandler.

"You will get under way at 10:00 o'clock to-morrow morning. Stand out to sea, report your position every hour by wireless telephone and you will return in time to anchor off the mouth of the Potomac not later than noon Monday."

The order was complied with. All day Sunday, as the big sea warrior ploughed through the waves off the capes of the Chesapeake, she maintained her communication with headquarters by telephone.

"It was not in the "orders of the day," but fifty miles out at

sea, Captain Chandler "rang up" his wife at Washington, arranged for her to meet him at the wharf on the following Tuesday, and "rang off" after a parting greeting, to talk with Lieutenant Snyder at the Great Lakes Naval Station, more than two thousand miles away, and Captain Bennett, Commandant at Mare Island Navy Yard, off on the Pacific coast.

IV

The public opened its eyes. It had listened much to gloomy tales of our weakness, due to our general condition of unpreparedness. But here was a startling revelation of strength in a fundamental quarter.

Whatever else our military and naval resources might develop in case of war, we were at least possessed of a system of electrical communication—the first line of offense and defense—whose strategic value overwhelmingly surpassed anything of the kind that any nation had to offer.

While this mobilisation test of the forces of communication was going on, the submarine issue had been opened again. The Kaiser's promise to sink no more liners without warning and without safety to the lives of non-combatants, had been converted into another "scrap of paper." The *Sussex* had been attacked without warning by a German submarine, and twenty-five American citizens sent to the bottom. President Wilson had delivered what amounted to an ultimatum, and this drew forth another promise, grudgingly given, to refrain from the murder of American citizens. In this case, however, the promise was accompanied by a string, by which, when convenient, it could be yanked back and the campaign of murder resumed without further preliminaries.

It became convenient to pull the string on the last day of January, 1917.

Germany, with much boastfulness of superior strength, had held out to the Allies a decidedly questionable olive branch, and the hypocritical peace offer had been very properly spurned.

President Wilson, in the meantime, had forwarded a note to all the belligerents, looking to a basis for reaching an agreement as to peace terms. On January 22, 1917, he outlined before the Senate his views of a just peace and proposed that the United States enter a league for the enforcement of peace.

Germany's answer to President Wilson came on January 31, 1917, in the form of a six-hour notice delivered to Ambassador Gerard that submarine frightfulness was to be resumed, and that all vessels of whatsoever character encountered by German submarines were to be sunk on sight.

At two o'clock on February 3, 1917, Count von Bernstorff received some important documents.

They were his passports.

Diplomatic relations had been severed.

PART II

FROM FINGERS TO FIST

CHAPTER V

ON THE BRIDGE AT MIDNIGHT

HERE is a picture torn from an old frame.

It was midnight. Provincial Boston was sleeping a restive sleep. A lonesome whippoorwill winged its weary flights to a deserted spire and disturbed the stillness of the night. Velvet-footed creatures prowled in places forbidden by day. Elsewhere an army folded its tents and stealthily marched in the dark.

In a distant telephone exchange, a vigilant operator kept silent sentry over a city disturbed by rumors of war. A light suddenly burned on the switchboard. She plugged in, eager to know who was active at such an hour.

"This is Paul Revere!" and the voice was filled with excitement. "I must talk to Concord and Lexington. Hurry, Central, my business is urgent!"

Quickly the operator built up a line to Lexington, and started another to Concord.

"Lexington? Sound the alarm! The British are moving troops across to Charlestown. Tell Hancock and Adams to get safely away," and Revere hung up the receiver with a bang.

Immediately the bell tinkled.

"I have Concord waiting. Are you ready to talk?"

"Put them on. Concord? Revere speaking. General Gage is sending 800 troops across the river by way of Charlestown. Rally the minute-men and defend the depots."

And then Paul Revere went to bed, having done his duty.

But alas! what dream can change the unalterable past? Paul Revere had no telephone in his room at midnight on April 18, 1775. Where a desk stand might have been, stood a muzzle-loading musket. And Paul Revere was nowhere around. He shivered on yonder shore of the Charles until two lanterns were hung in the North Church steeple, and then he galloped away on his midnight ride, warning the country-side that the British were coming. He dashed through Medford, Arlington, past Lexington and into Concord, preparing the stage everywhere for the first act of the great drama of the American Revolution. And the poet Longfellow tells us:

> That was all! And yet through the gloom and the light
> The fate of a nation was riding that night.

No idle fancy, this.

Early in 1917, as in 1775, the foe was literally at our gates, and we were at the threshold of a revolution which was to affect the daily lives of every man, woman and child in America.

It was midnight. We did not know it. Many of us—very many—were sleeping a restive sleep. All about us, velvet-footed creatures prowled in places forbidden by day. They were prowling for the Fatherland.

A hundred million souls had to be awakened to the reality of a danger that menaced our very existence. Most of us comprehended the danger only in an academic sense. We saw it through a glass darkly.

How to awaken a *real sense* of that danger, how to arouse a nation steeped in the habits of peace and scattered over

an area fourteen times that of France or Germany, twenty-five times that of England; how to sound the tocsin in such a way that it could be heard and understood by all, that it would arouse not merely attention, but action, light the fires of patriotism, quicken the pulse, brace the muscles, fortify the resolution, *unite*,—that was the problem America faced in this great hour of her destiny.

It was not merely a crisis in our national existence: the fate of the world hung in the balance.

Time was of the essence. Hours counted. Potsdam was plunging forward, Time its ally. Ships were being sunk at the rate of nearly a million tons a month. Starvation stared the Allies in the face. England had but a few weeks' supply of food on hand. Fortune seemed to be favoring Germany at every turn. Blow after blow had fallen upon the vast forces of Russia in the eastern theatre of war. Warsaw had been captured, Brest-Litovsk had fallen, Grodno and Vilna had followed suit, revolution ensued, and it began to look as if Russia was to be permanently out of the reckoning. Serbia had been crushed and Roumania subjugated. The Bulgarian host, numbering some 500,000 effectives, had joined their fortunes to those of the German Empire and had opened up a vast granary of food supply to sustain the victorious forces of the Central Powers. Britain seemed to be in desperate straits; her ministry fell; a new one took its place. Things looked dark indeed for the Allied cause.

Was America to make any difference? Many doubted it. But if she *was* to count, she must move, move fast, and move in one direction.

We were certainly "on the bridge at midnight." No one knew what next to expect. We had broken off diplomatic

relations with Germany. Did that mean war? No one could tell. For the time being, we were neither at war nor at peace. There was much heat, but little light: cloud above, space below, dismal darkness ahead.

But if it is true that up to well toward that midnight hour we had done little by way of military preparedness on a national scale, it is also true that within a remarkably short period of time a considerable amount of water had passed under the bridge. A year before, it was a feeble trickle. In a few months, it had swollen to a foaming torrent. In an equally short space of time, it was to widen into a sea.

Let us glance, for a moment, at the various currents that had developed with such remarkable speed.

CHAPTER VI

UNDER THE BRIDGE

It might have been different had not Walter S. Gifford made a slip of the pen and written on his envelope, as a youthful seeker of a job, the name "Western Electric" instead of "General Electric"; had not John J. Carty directed so many of the transcontinental and wireless telephone exhibits; had not Hugh L. Scott and Josephus Daniels attended the National Geographic dinner; had not George O. Squier returned from Europe when he did; had not Carty and Howard E. Coffin been thrown together by similar engagements; had not—

But let us tell the story in an orderly way.

At the close of 1914, the American people, though not pacifistic in the sense later conveyed by the term, had assuredly no wish to interfere in a struggle then viewed as purely European.

But as the submarine issue continued to tug at the tightrope of neutrality, sentiment for military preparedness began to well up from the common sense of the people: a public utterance here, a private opinion there, a dinner conversation, a smoking-room discussion, an article in a magazine, a sudden multiplication of editorials on the subject,—and before long the topic was on the lips of every live American.

In August, 1915, at the instance of Leonard Wood, with the heartiest voluntary support from all over the country,

the first Plattsburg camp was established. A month before, the Naval Consulting Board was created, with an advisory committee headed by Thomas A. Edison, supported by the country's leading inventors and engineers. President-Elect John J. Carty, of the American Institute of Electrical Engineers, was naturally called upon to co-operate, and upon his nomination, two engineers of national fame, Frank J. Sprague and B. J. Lamme, were selected to represent the American Institute on the Advisory Committee. Howard E. Coffin, Vice-President of the Hudson Motor Car Company, was selected as Chairman of the Naval Consulting Board's Committee on Industrial Preparedness.

Coffin was a steam engine in breeches. He promptly drew up an elaborate census blank, in the shape of a questionnaire, to be submitted to every industrial plant, large and small, in the country. No sooner was a first proof struck off by the printer, than Coffin submitted the blank to Carty for his criticism. Carty returned it with his comment, and Coffin lost no time in arranging for an appointment with the critic.

"This industrial census," said Coffin, "is vastly important. It will reveal the industrial possibilities, present and potential, of every factory, plant and machine shop in the country, so that in case of war, we will know exactly where to go for what we need. Can you take hold of the thing and put it through?"

Carty had his hands full. He was at that very moment engaged, in co-operation with Army and Navy officials, in laying plans of far-reaching military importance in the field of electrical communication. Besides that, as President of the American Institute of Electrical Engineers, he had been called upon by President Wilson to mobilise, for co-operation with the Industrial Preparedness Committee of the

Naval Consulting Board, the electrical engineering personnel in every state of the Union.

"I will tell you what, though," said Carty, "I can recommend to you a man who will do a One Hundred Per Cent job, if anybody will; a young man of remarkable ability named Gifford, who is at present the statistician of the American Telephone and Telegraph Company."

"Ask him to come over," replied Coffin. "I'd like to have a talk with him."

Gifford saw Coffin. They had a talk. And Coffin, a student of men, hesitated not, but prevailed upon Gifford to arrange with his organisation for the necessary time to be devoted to the task.

The mind harks back to a certain summer's day in the country, which Gifford and the author spent together. We had roamed all day through the woods, and on the homeward train that evening were exchanging reminiscences. We were discussing the large part accident played in life.

"Do you know," said Gifford, "it's only through the merest accident that I became connected with the American Telephone and Telegraph Company. I was just fresh—very fresh—from my study of the Harvard classics. I wanted a job. I didn't know just what kind of a job I did want. But I heard that the General Electric was hiring college men. So I wrote them a letter applying for a job. But when I came to writing the address on the envelope, I must have been thinking of something else, because instead of writing 'General Electric', I wrote 'Western Electric.' And in a few days, I got a reply, offering me a job in Chicago at ten dollars a week. I accepted, and took the train for Chicago, with $50.00 in my pocket. On the way I lost the $50.00—but I had a job."

At Chicago, Gifford proved a clerk with a mania for ideas. Whatever he had to do, he did thoroughly, but he never saw his "boss," without the everlasting interrogatory, "What do you think of this idea?" And the ideas usually took. His chief passion was for facts—correlated, concisely stated facts, which would focus a volume of essential information onto a single page, to serve as a compass for action. Without knowing it, Gifford was qualifying himself for the position he was subsequently to attain in the large affairs of government, of big business, and of finance.

When the headquarters of the Western Electric Company were transferred from Chicago to New York, Gifford was included in the transfer. At New York, his work immediately attracted the attention of the administrative officers of the American Telephone and Telegraph Company. He was appointed Chief Statistician of that company. In his new position, Gifford soon demonstrated that he was not only a master of accountancy, but that he had the ability, as well, to analyse and to present, in clear business form, the activities which lay behind his statistics: the *realities,* of which, after all, figures are but a symbol.

By the time Coffin enlisted Gifford's services, Gifford had come to comprehend the United States in a very real sense. He was accustomed to think constantly in terms of underlying national conditions, geographical, economic, and industrial. He had a statistical medium for assessing every basic business factor, from the general trend of prices, to the specific business requirements of any given locality in the country. And he could combine and co-ordinate these facts into a central scheme that left nothing to the imagination.

So it is no wonder that when he took hold of the Industrial Census, he did exactly what Carty said he would

do—a One Hundred Per Cent job. He exceeded Coffin's expectations. Twenty-seven thousand industrial plants were inventoried, answering every conceivable question that Uncle Sam might want to know if and when he began to fight: where shrapnel could be produced, how much, and at what prices; where shoes could be had for marching men, spades for trenches, wire for entanglements, rifles, cannon, powder, horses, tents, automobiles, clothing, helmets, steel rails, cars locomotives,—anything and everything that might be needed when the time came; and these facts were tabulated and converted into concise, consistent, accurate form.

Thus it came about that when the Council of National Defense was organised, Secretary of War Baker requested the loan of Gifford's services, and Gifford was given an indefinite leave of absence to serve as Director of that agency which did so much to redeem us from the sin of unpreparedness.

In the meantime, another important current in the stream of preparedness had set in. Way back in the sixties, President Lincoln had affixed his signature to an Act of Congress creating the National Academy of Sciences. This organisation, crowned with the dignity of years, and embracing in its membership the highest scientific personnel of the country, now came forward with a proposal to the President of the United States that it bring into co-operation the leading American scientific investigators and engineers, representing the Army, the Navy, the Smithsonian Institution, and every national scientific bureau, educational institution and research laboratory capable of effective co-ordination in the employment of scientific methods for the national defence. The President accepted the offer, and by executive order dated May 11, 1916, created the National Research Council, of which Dr. George E. Hale became President, and Carty

Chairman of the Executive Committee. "Mobilisation of the cloistered nook" was the slighting term applied in some quarters to this organisation at the time of its inception; but it was to play a prominent and perhaps unforeseen part during the years that followed, when Carty and others were to find in this body a reservoir of scientific ability on which they drew liberal and timely drafts for war service of the first order.

During the war, the National Research Council functioned as the Department of Science and Research of the Council of National Defence.

It will be remembered that early in March, 1916, Major-General Hugh L. Scott, Chief of Staff of the United States Army, attended the dinner of the National Geographic Society, as Secretary of War *ad interim*. "It was a very interesting experience," wrote Scott to Carty, several days later, "to sit next to you the other night and witness the wonders you performed. It was an occasion I shall never forget." There began an *entente cordiale* between these two men, marked by their active co-operation in the matter of preparedness. The Army and the Bell System were in touch. In January of that year, at the request of General McComb, President of the United States Army War College, Carty had delivered a confidential lecture to that body at Washington on the subject of "The Organisation, Plant and Personnel of the Bell System." The address made such a deep impression on these military experts, that Carty was asked to give a similar talk to the Naval War College, which he did several weeks later. Thenceforth, no military or naval plans were developed that failed to take the Bell System fully into account.

The Hay-Chamberlain Bill was at the time being vigorous-

ly debated in Congress. General Scott promptly sent Carty a copy of the proposed legislation as soon as it took on definite shape. Both "watched and waited," each intent on his own angle of action when the time came: Scott surveying the entire scheme of military operations, and Carty planning how to fit the Bell System into that scheme.

On June 3, 1916, the President signed the Hay-Chamberlain Bill. Carty immediately went to Washington and conferred with General Scott.

"We are ready," said Carty, "to take what steps are necessary. I have a plan that fits the Hay-Chamberlain Bill. I think it properly concerns the Signal Corps."

The plan was a very definite one indeed.

The Hay-Chamberlain Bill provided for an Officers' Reserve Corps, to be recruited from civilian ranks and commissioned in the various army branches, according to the specialised training and qualifications of candidates. Officers holding such commissions were to be subject to immediate call when the exigency demanded.

A committee of engineers representing the four national engineering bodies, including the American Institute of Electrical Engineers, of which Carty was President, had been conferring with Army authorities in the matter of forming an Engineers' Reserve Corps. Carty was called upon to line up with this proposed organisation the vast body of telephone and telegraph engineers affiliated with him in the American Telephone and Telegraph Company and Western Electric Company. These engineers, taking time by the forelock, were beginning to plan for themselves, to consider ways and means for entering the army reserve service. Some of them were getting restless. Their patriotism demanded some kind of action. Why not the Engineering Corps?

"Sit tight," advised Carty. "This thing is not drifting: it is being steered along a safe and sound course. Plans are now under consideration how best to utilise our organisation, plant and personnel in time of war, and how to stand prepared in time of peace so as to be ready in time of war. I am sure that a comprehensive plan will emerge which will take care of all that we can best do to serve the country."

And so when Carty called upon Scott, the latter turned him over to General Scriven, then Chief Signal Officer.

"The Bell System," said Carty, "has pledged its entire organisation, plant and personnel to whatever service may be required in whatever emergency. The personnel embraces a large staff of highly trained engineers, who are ready and anxious to do their part. It has been suggested that this personnel ally itself to the Engineering Reserve Corps which is now forming.

"The Engineers' Corps of the Army has to do with the construction of fortifications, bridges, etc., in time of peace, and also in time of war. In war time, the establishment of pontoons, bridges and the construction and repairing of railroads, bridges, etc., the building of roads, and work of that character falls to the Engineers' Corps. This Corps does not have charge of the telephone, telegraph and other forms of communication required by the Army in time of peace and war.

"All of this signalling work comes under the Signal Corps, and no provision is made for it in the activities of the engineering societies above mentioned. In time of war, the supply of men for the Signal Corps would come largely from the American Telephone and Telegraph Company, its as-

sociated companies, the Western Electric Company, and the telegraph companies.

"Inasmuch as the matter of enlistment in the Engineers' Reserve Corps is shortly to be taken up with the members of the engineering societies, the question will arise among our own men as to what they should do with respect to entering this corps."

"We are studying the situation," advised General Scriven, "and as soon as the matter of a reserve corps for the Signal Corps is definitely determined, your Company and all other similar organisations concerned will be advised."

Carty awaited developments. He cautioned his own organisation to wait. From time to time he dropped into the office of the Chief Signal Officer, to keep in touch. He was not taking any chances on a slip-up.

One day, in Scriven's absence, Carty ran across a keen-eyed lieutenant-colonel, a small, wiry, nervous man, with coal-black eyes that always looked straight out in front of him; a man that walked briskly, as if he knew where he was going.

This man was George O. Squier, known for the singular circumstance that he was one of the few army officers who could write "Ph.D." after his name.

Before many months had elapsed, Squier was to advance to the rank of major-general, and to assume the destinies of the Signal Corps as its Chief Signal Officer.

He was indeed a remarkable type of army officer. Born in 1865, graduated seventh in a class of 65 at West Point, he was in 1887 appointed second lieutenant in the Third Artillery at Fort McHenry, Baltimore, where he put in all his spare time studying physics at Johns Hopkins University under such internationally famous physicists as Rowland,

Remsen and Newcomb. There he laid the basis of his scientific knowledge, being made a fellow of this university during the years 1902, 1903 and 1904, and receiving his Ph.D. in 1903.

In 1907, while the Wright brothers were trying to sell the idea of military aviation to the United States Government, Squier at once perceived the vast possibilities of this new means of warfare, and was selected by the War Department to draw the specifications for the first army airplane—the first military airplane, in fact, ever constructed for any army in the world. On September 12, 1908, in charge of the first tests at Fort Meyer, Squier made the first ascent on record as a passenger in an airplane. When the World War broke out, Squier, who was then serving as military attaché at the Court of St. James, was transferred to the post of military observer with the Allied armies, and in May, 1916, was recalled to Washington, to assist in building up the new Signal Corps.

Carty found in Squier a man with definite ideas as to the immediate future, and a readiness to translate these ideas into action. He was fully posted on the subject uppermost in Carty's mind, and eager to follow every new development. And he saw at once the full significance of Carty's proposal.

It was a break from tradition. The orthodox Army method of recruiting Signal Corps personnel was to detail men from the Cavalry or the Infantry or some other arm of the service, into the Signal Corps. So long as the Signal Corps remained what it was at the close of the Spanish-American War,—wigwagging, old Morse telegraphy of Civil War vintage, the operation of a few imperfectly constructed and poorly working telephone lines,—so long, in other words as the old, rudimentary, Spanish War idea of Signal Corps tech-

nical requirements survived in the Army, the system of detailing Cavalry, Infantry and other officers to Signal Corps work made very little difference in the net result.

But we were in the midst of a new age of warfare that superseded Civil War and Spanish-American methods as completely as the machine-gun had superseded the flintlock. Scientific methods had transcended everything else. It was a warfare of Science, *par excellence.* And it had transformed the Signal Corps requirements more completely, perhaps, than those of any other military function.

Squier saw this with the vision of a naturally progressive mind enhanced by two years of direct military observation abroad. He perceived that the thing to do was to utilise, to the fullest degree, the highest technical skill of the country in the vast enterprise that lay before him of adapting the Signal Corps to modern warfare.

But *how* to utilise this skill was another problem. The easy method of utilising business or professional men in government work—sadly in evidence throughout the war—was to snatch them bodily from their environment, suck them into a rapidly swelling vortex of administrative confusion, and leave them, after a preliminary whirl, gasping for breath and helpless in a slough of innocuous bureaucratic existence.

I have seen lieutenants at Washington, during the war,—former business men of marked capacity,—checking cards, counting papers, endlessly plying sealing wax, or else doing nothing by the hour. They were alone—in a crowd of disorganised effort.

Squier perceived that the thing to do was to mobilise the *man and his environment:* in short, the organisation.

"Realising," said Squier, "the importance of this, some time in January, 1917, as I remember it, prior to the en-

trance of this country into the war, I went to New York, and had an informal conference with Mr. Theodore N. Vail, President of the American Telephone and Telegraph Company, and in particular with John J. Carty, in which the general outlines of the procedure in case we entered the war were talked over and arranged.

"The problem was, How could we pick from these organisations and other similar utilities the men and equipment needed immediately without crippling that essential service in the United States, where additional demands would be made in the vast industrial preparations required at home also?

"Manifestly this could be done only by thorough co-operation between the Government and the guiding heads of these utilities.

"The first move, therefore, made upon the outbreak of war was the commissioning of four or five of the leading engineers and executives in the commercial telephone and telegraph companies of this country, and these in turn were charged with the selection and organisation of the trained personnel to be sent immediately abroad to start the work while the new Army could be trained in this country. These engineers and executives, instead of being brought to Washington in the early days of the war, were left directly at their offices, where they had every facility organised, and they took their orders from the Signal Office in Washington.

"If the Chief Signal Officer had brought this first group mentioned above directly to Washington, as would have been the usual procedure, the time which it would have taken, under the congested conditions necessarily then existing in the War Department, to establish these officers and equip them with the office machinery required, and to learn the

intricacies of Army routine, would have caused the Signal Corps to lose a great deal of valuable time in getting the initial start in France.

"During the early months of the war, therefore, these officers in the uniform of their country, installed in their regular offices, with the full machinery at their disposal, represented for a time the United States as well as their former employers, and through the hearty co-operation and loyal support of all hands the Signal Corps was enabled to get under way with the ablest and most experienced technical men in the country in the shortest possible time."

Squier formally started the ball rolling by a letter to Carty, dated October 2, 1916. "It is the desire of the Signal Corps," he wrote, "to attract to its Officers' Reserve Corps the very best engineering talent in the country interested in our line of work. The American Telephone and Telegraph Company, the Western Electric Company, the Western Union and the Postal Telegraph Companies being engaged in work almost identical with the Signal Corps, it is very desirable that all these organisations be drawn upon in order that their wonderful resources can be utilised if necessary by the Government in any great national crisis. . . .

"It is the desire of this office to offer you the highest commission which it is possible to issue to a reserve officer—a commission in the grade of major—and it is also desired that this be the first major's commission issued by this office."

Carty immediately replied, expressing his appreciation of the tendered honour, and the next day saw him in Washington in conference at the Chief Signal Office, hammering out the brass-tack details of the scheme with Lieutenant-Colonel C. McK. Saltzman, later a Brigadier General, who was put in immediate charge of this work.

Thus was launched the Signal Reserve Corps—the most unique body of experts, perhaps, that ever functioned in any army.

And these were the various currents making up the stream that had been flowing under that bridge on which we stood at the midnight hour: the bridge of transition from neutral to combatant.

The country had not been idle during these fateful months. Individually and as a nation, long and rapid strides toward preparedness had been taken. There was, of course, much that still had to be done—so much, that when we now look back upon this period, we do not wonder at the pessimism that prevailed in many quarters. The most pronounced of these pessimists pointed to our utter lack of a trained army, to the utter absence of adequate facilities for the manufacture of weapons of war, to what seemed like a hopeless muddle of administrative confusion on the part of the Government. But this pessimism was not fully warranted. We were at least on the way. We had done just enough so that what was done later was possible to be done. Had we done less, the final outcome might indeed have been doubtful.

CHAPTER VII

GETTING TOGETHER: THE COUNCIL OF NATIONAL DEFENCE

CONSIDER the plight of the harried centipede:

> The centipede was happy
> Till the frog one day in fun
> Said, "Pray, which leg comes after which?"
> Which wrought him up to such a pitch,
> He lay distracted in the ditch—
> Considering how to run.

And that was precisely the plight this country faced during the latter part of 1916 and the early part of 1917, when we were suffering the pangs of impromptu preparedness. For there can be no doubt that the tumult of events crowding in upon us in the brief space of a few months caught us, in many far-reaching respects, considerably unprepared.

If we stopped too long to ponder, to introspect, to lie "distracted in the ditch," we were lost. We had to run—just naturally run. And we had to get all our national legs in motion at one and the same time, without getting them tangled.

In the midst of an enormous commotion, a tremendous babble of voices, a vast variety of counsels, a grave danger of futile stampede, there arose the imperious necessity for one, clear voice, and—what was more important—for an agency capable of acting as a single guiding hand not only to unify existing governmental agencies, but to co-ordinate with them

and with one another the vast commercial, industrial and agricultural resources of the country.

We needed a get-together machine to handle a situation for which there was neither precedent, nor governmental agency designed to handle it.

If ever again America is threatened with a grave crisis, let no pessimist doubt the genius of a free people to adapt itself to any given emergency. For nowhere in all history do we find a more reassuring illustration of this latent quality in our own democracy than in the organisation of the Council of National Defence.

It began as a purely voluntary affair. It was the people's affair. It arose out of no legislative doctrine or ready-made theory of government: it simply grew out of the necessities of the moment.

The Committee on Industrial Preparedness had pointed the way. Large business and industrial corporations, and the huge systems of transportation and communication, stood ready to co-operate with the Government, if only a practical medium could be established for most effectively utilising this co-operation.

It became obvious that a connecting link was needed between the Nation in its normal state, and the Nation as a machine for making war.

On July 25, 1916, Congress gave its official baptismal recognition of the Council of National Defence, by a Senate amendment to the National Defence Act—or Hay-Chamberlain Bill, as it came to be called. The Senate amendment was approved on August 29, 1916, and the Council of National Defence was thus given a sanction which the Naval Consulting Board had never possessed.

The purpose of the Council was officially defined as "the

creation of relations which will render possible in time of need the immediate concentration and utilisation of the resources of the nation."

There was thus set up a definite medium for effecting the best and quickest methods of mobilising troops, the kind of supplies needed for national defence, the quickest and most efficient methods of producing those supplies by the speediest means of transportation and communication for use against an enemy.

And there now existed not merely a means of mobilising America's material resources, but what was far more important and underlying the entire scheme, there was provided a medium for mobilising that still greater asset, the spirit of the men and women controlling these resources; the fluid but inchoate patriotism of America's vast army of citizens.

The essence of the Council's function was co-ordination, and co-ordination is merely another term for the intelligent correlation and effective use of statistics, whether they concern a factory for making pins, or the activities of a nation. It was therefore an altogether fitting and happy circumstance which destined Gifford, the statistician of a nation-wide telephone and telegraph service, for service as Director of the Council of National Defence.

The Council was made up of six cabinet members, including the Secretaries of War, Navy, Interior, Agriculture, Commerce and Labor.

On October 11, 1916, an Advisory Commission to this Council was announced by the President of the United States, consisting of the great business, labor and transportation heads of the country.

Each member of the Advisory Commission became also

head of a Co-operative Committee, and the Council, through this system of committees and sub-committees, began to branch out into every field of business endeavour contributing directly or indirectly to military effectiveness.

It became the nerve centre and motive power of our vast industrial and commercial resources, co-ordinating and concentrating their activities to a point of highest military usefulness.

Daniel Willard, President of the Baltimore and Ohio Railroad, as Chairman of the Council's Advisory Commission, became also head of a Committee on Transportation and Communication. This committee, in turn, consisted of three sub-committees, one on Telegraphs and Telephones, one on Railroads, and one on Electric Railroads.

Theodore N. Vail was made Chairman of the Committee on Telegraphs and Telephones, which included, also, Nathan C. Kingsbury, Vice President of the American Telephone and Telegraph Company, Newcomb Carlton, President of the Western Union Telegraph Company, Charles P. Bruch, Vice President of the Postal Telegraph Company and F. B. McKinnon, Vice President of the Independent Telephone Association.

Thus were the wire systems of the country brought into harmony under effective governmental direction.

There began at once the central task of co-ordinating, extending and maintaining at the highest point of efficiency a vast web of electrical communication, comprising twenty-six million miles of telephone wire and two million miles of telegraph wire, and connecting the city of Washington with every town and hamlet in the country.

CHAPTER VIII

GEARING UP

TAKE two men. Both are normal, healthy, erect figures, both pursuing a peaceful routine. Confront them with a sudden emergency.

One stares in helpless awe, pauses, ponders, is perplexed what to do. The other reacts promptly, rises to the occasion, shows a sudden burst of speed that no one, not even himself, would have suspected.

What is the reason for the difference?

One lacks what the other possesses: a store of reserve energy, and a sound nervous system that needs but to be "geared up," to meet a given emergency.

What is true of the human body is true of the body politic. For if geography may be termed the anatomy, and transportation the arterial system of a country, telephony and telegraphy may be viewed as the nervous system of our entire economic and social structure.

In February, 1917, our country, possessed of an enormous store of reserve energy, and the most perfect nervous system in the world, needed but a "gearing up" to meet the crisis with which it was confronted.

To respond promptly to the need of the hour, we had to employ to the fullest extent, with all possible speed and dispatch, the "live wire" system of nerve communication with which the country was splendidly supplied.

Carty was in his office when the news reached him that diplomatic relations had been severed. He immediately called for his secretary.

"Get me a reservation on the next train to Washington," he directed.

"So far as I was concerned," he told me later, "the fight was on. From that time forward, we were at war with Germany—at least insofar as my own plans were concerned."

Carty had not been idle. He had conferred with the President of the War College. He had conferred with the Chief Signal Officer of the Army. He had conferred with the Director of Naval Communications and other officials of the Navy Department, and with the Council of National Defence. Preliminary plans had been laid and everything had been set to "go off" in case of emergency.

That emergency, Carty felt, had now arrived.

He hastened to Washington, and immediately took up with the Council of National Defence, the President of the War College, the Chief Signal Officer of the Army, and the Director of Naval Communications, the various threads that had been woven into an all-embracing pattern of preparedness.

Washington had been transformed overnight.

From a tranquil town of peaceful routine, the city had suddenly become a beehive of military activity—the hub of a tremendously active wheel whose spokes radiated to every part of the country and beyond to the battling Allies.

It was a dramatic torrent of human activity: crisp words of command shooting back and forth in every direction, widespread offers of service from every conceivable walk of life, incisive reports from military leaders, terse instructions to distant posts, hurried messages from kings of finance and in-

dustry, requests of harassed governments, desires of dying dynasties, the urge of a defenceless people, tales of victory and defeat, the plaint of the wounded and the plea of the hungry—all clamouring at the heart of the nation over multitudinous tiny copper wires.

Within a few months, this centre of our web of military communication, bursting its normal bonds, had more than doubled its telephone traffic. Long distance calls, leading out of Washington and all over the country, shot upwards by leaps and bounds. Great metropolitan and industrial centres precipitated unprecedented demands upon the telephone service.

An enormous compression of time and space; but also an enormous problem.

Put two men in a room and let them talk together. Multiply the number by two, multiply that by a dozen, and keep multiplying until the total reaches into the millions. Imagine, then, these clamouring millions assembled together, suddenly touched by an event of transcendent importance—what a hubbub! And then think of the tremendous confusion that would result if each tried to talk to the other without adequate, orderly means of communication.

Every nerve in America's body was now tingling. Every long distance wire of electrical communication was alive with throbbing impulse. These wires must not be overcharged, they must not be overcrowded with the tremendous traffic of speech through space, or down would tumble the whole structure like a house of cards, delay irreparable would follow the collapse and—TOO LATE would be the epitaph on the tombstone of democracy.

Therefore, the toll or long distance telephone line situation throughout the country had to be carefully checked

in detail and provision made so that the Government would receive adequate toll service despite the rapidly rising tide.

Fortune favoured America in the first instance. The situation was unusually well in hand to begin with. A network of wires lay spread across the face of the entire country, reaching three times as many telephones as there were in all the embattled countries of Europe put together. Good telephone service could be given to the headquarters of every army department and naval district in the United States.

But a great deal more had to be planned and done, and that *immediately*. No time was to be lost in building up the long distance telephone facilities in and out of Washington. At the head of the so-called "Long-Lines" organisation of the American Telephone and Telegraph Company, was a keen-minded, plain-spoken engineer, named F. A. Stevenson; a man of exceptional vigor, with a direct way of going about things. Stevenson, at this juncture, though a man past 50, laboured prodigiously during all hours of the day and night to meet the emergency which had arisen, and his organisation, taking the cue from its chief, performed accordingly, multiplying their efforts and expanding the wires over which the tremendous traffic was beginning to rise to unheard-of proportions. At the time diplomtic relations were severed, there were but 148 wires in and out of Washington. Within the space of three months, this number had been doubled!

And now a new problem presented itself—that of finding raw material. Copper, for example. Copper by the thousands of tons had crossed the waters and disappeared down the gaping jaws of Allied war industry. Additional thousands of tons had been requisitioned in advance of their output. A similar scarcity ran through the gamut of the other raw material required by the vitally pressing telephone pro-

gram. Even where obtainable, the raw material had soared in price to the loftiest of altitudes. But the wherewithal simply had to be forthcoming. Vail was planning to manufacture and lay out an entirely new underground cable all the way from Washington to New York, to contain over 80,000 miles of wire, and to provide at the same time for added service to Baltimore, Wilmington, Philadelphia, Trenton and other important cities. And so a special group of experts were put on the trail for canvassing the raw material resources of the country. It is a mystery to this day how these sleuths, with every Allied and American war industry on a similar trail, unearthed the necessary raw material; but they did, and the programme went forward full speed ahead.

All the while this underground cable from Washington to New York was in course of construction, work was proceeding upon the stringing of copper wires out of Washington in as many directions as the manufacturing resources and availability of raw material would permit. The plans were not restricted to limited percentages of increase. Vail was determined to "plan large," with no limit except that imposed by raw material and capacity for manufacture.

The early plans, therefore—two months before America declared war—contemplated about 500 long distance wires radiating from Washington.

"Foolish, unnecessary and impossible," was the verdict of an alleged expert at the time, especially in view of the fact that it involved a vast amount of work outside of Washington in the face of a seemingly insurmountable handicap in raw material and manufacturing facilities.

Before many months had elapsed, it had become evident that this program was neither foolish nor impossible; and

as for its necessity, it gave certain officials a chilly feeling down the spine to think what would have happened without it.

And then there was the transcontinental line between New York and San Francisco—the longest telephone line in the world.

Between New York and Chicago, of course, there had been a plenitude of circuits for years. But from Chicago on to San Francisco, one circuit for existing commercial through business had up to this time proved ample. Business men were not yet crowding each other for the privilege, at the price necessitated by the enormous cost of the line, of talking between the Battery and the Golden Gate.

It did not take long to realize, however, that in case of war, commercial considerations would have to be relegated to the limbo of peace-time routine, and that a tremendous increase in traffic was about to take place over the transcontinental line, on missions of vital national importance.

Within a short time after the severing of diplomatic relations, therefore, Stevenson and his crowd had completed work for providing two more circuits the entire distance from Chicago to San Francisco, thus making three transcontinental circuits available for long haul business where but one existed at the time von Bernstorff began his homeward voyage.

Added to all this, a large number of special telephone and telegraph wire circuits had to be lifted bodily, as it were, out of general commercial use, for the special and exclusive needs of Uncle Sam. In addition to setting aside the circuits themselves, it was necessary to provide a large amount of special equipment at many important points. Within a short time, over 10,000 miles of such special systems had



COLONEL JOHN J. CARTY



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been taken from commercial use and devoted exclusively to the service of the Army, Navy and other Departments of Government.

Then, at the request of the United States Coast Guard officials, Stevenson and his experts went into conference with the naval officials concerned, and together they worked out complete plans for the enlargement of the United States Coast Guard telephone system on the Atlantic, Gulf of Mexico and Pacific coasts.

The work was done quietly and effectively. Little was heard or known of it at the time. But that it was work of the most exacting character, a single instance will suffice to make clear. Early in February, 1917, instructions were received to make a thorough inspection of the U. S. Coast Guard telephone lines from Toms River to Cape May Point, on the New Jersey coast—a distance of 120 miles. "A report is requested," the instructions concluded, *"within 36 hours."*

It would have been a difficult task to complete within a week—or a month, for that matter; for the existing line was constructed along loose and treacherous beach, over sand dunes, marshes, waterways, bays and inlets, making it necessary to utilise every available means of transportation, including automobiles, railroads, hand-cars, horseback, motor and row boats. A large portion of the line had to be covered on foot, as the greater part of it stretched through uninhabited country, with no accessible roads.

With little time for eating and not much more for sleeping, the inspection gang went over every inch of that line, and within the allotted 36 hours, submitted its report.

The line was found miserably inadequate and unfit. "Build it all over again," was the burden of the report. And

so orders came back from the Navy to rebuild the entire line. Back to work went the telephone crews. But this time the work was completed under conditions far worse than those encountered during the inspection. Sleet storms ran icy and excoriating fingers across the faces and hands of the crews, heavy weather added to the burden, lack of shelter made life almost unbearable. Transporting their poles and material on boats and rafts, through heavy ice-fields and storm-tides, frequently drenched by seas and storms, and suffering severe hardships, the men stuck to the task and completed the job on schedule time.

In the meantime, naval requirements of a different character were absorbing the energies of still another branch of the great family of telephone and telegraph workers. In that remarkable laboratory of the Bell System occupying thirteen floors of the building at Number 463 West Street, New York City, the corps of Western Electric inventors and engineers to whom reference has already been made, together with expert engineers and scientists of the American Telephone and Telegraph Company, had been working for months in close and confidential co-operation with the officers of the United States Navy on wireless methods known only to themselves and the Navy, and on improvements to the best hitherto known means of detecting the presence of submarines. An astounding bagful of surprises lay in store for the war-torn world of the immediate future, as a result of the numberless experiments which these engineers were conducting in every electrical direction of possible military value.

The country had awakened with a start. The blaze of energy that now set in was not confined to any one locality or any one of the million rushing currents of human activity. The burst was simultaneous. But not all of it was equally

vital. Unless something was done to direct the furious stream into channels of relative urgency,—into a system of carefully administered priorities,—foam would take the place of flow.

First and foremost, the extraordinary needs of the Army and Navy must be given a clear right of way. About that, there could be no question. But how give them the right of way?

Elaborate plans were worked out whereby, in every part of the United States, all governmental toll calls, including all departments and officials, were to be given precedence over commercial business.

This meant that some 12,000 long-line operators in different parts of the United States were to be specially trained in the handling of this all-important work. Not only were they to be specially trained, but they had to be carefully selected upon the basis of the most exceptional personal fitness, for it was not merely a task of expert operating that this bright and eager feminine army was called upon to perform. In expediting the calls entrusted to them on the basis of relative national importance, they had to exercise judgment of the highest order, courage, patience, good sense and no small amount of tact. And they certainly rose to the occasion—these valiant little soldiers of the switchboard. In an amazingly short time, they became walking editions of the war-time "Who's Who," posted to the last minute on our national activities, and on the greater and lesser personalities at the many-spoked helm of the Ship of State.

But these unparalleled demands of the Army and Navy came at one and the same time with a similarly extraordinary activity all over the country on the part of commercial and manufacturing enterprises furnishing the sinews of war.

From the steel centres of Pittsburg and Bethlehem, from the shipyards on the Pacific and the shipbuilding industries on the Delaware River in and about Philadelphia, from the arsenals and gun factories, from the great powder works of the DuPonts and the numerous shell-loading, bagging and munition works of the East, from the miners of the Northwest, the motor and automobile manufacturers of the Great Lakes region, the thousands upon thousands of plants, factories, storehouses and shops scattered all over the country and supplying the Government with war material of every conceivable description,—there began to rain in upon the telephone organisations of the country a veritable deluge of claims for priority in construction, installation, maintenance and traffic. These demands, too, must be met, promptly met, and met with due regard to the thousand and one shadings of relative military urgency.

And when, pray, was an industry a war industry? It was not always an easy question to answer. For many were those who, demanding urgent telephone service, conceived their needs to possess a military importance not always in proportion to the national scheme. And yet, despite the chorus of conflicting claims for priority, there was at bottom a spirit of patriotic subservience to the public need,—the spirit of sacrifice which was abroad in the land,—and it knew no class or social station.

All over the country, among the various local Bell operating companies, special organisations—"War Service Committees"—were set up to handle with minimum delay and maximum effectiveness the various war needs of the nation. At the head of each War Service Committee was a chairman, directing a force whose function it was to give first attention to all military needs; to insure a clear track ahead for what-

ever Uncle Sam required. These War Service Committees toiled day and night to bring to the fore, in the shortest time, every available item in plant and facilities required by the Government for war purposes.

Finally, the situation had to be handled without suffering a breakdown of the entire structure, and under the added handicap of a rapid depletion in labour force. For the telephone organisation all over the country now began to shrink at an alarming rate, as it poured out a steady stream of trained personnel in answer to war's demands,—thousands of telephone experts being supplied for Signal Corps work, additional thousands of highly trained telephone operators transferred to government duty, to say nothing of the widespread exodus of trained personnel through channels of enlistment in other branches of the service, as well as to higher paying war industries.

Strain from without, drain from within, but no collapse; that was the all-important condition which had to be met while the nation "geared up" to its trial at Armageddon.

The strain increased, the drain increased, but there was no collapse.

CHAPTER IX

OVER THE BRIDGE

To such a task we can dedicate our lives and our fortunes, everything that we are and everything that we have, with the pride of those who know that the day has come when America is privileged to spend her blood and her might for the principles that gave her birth and happiness and the peace which she has treasured. God helping her, she can do no other.

Thus we crossed the bridge.

Thus President Wilson closed his war message delivered before Congress at noon on April 2d, 1917.

Thus we definitely aligned ourselves with the cause of democracy which was being waged by the Allies against the most formidable menace to civilisation since the days of Attila.

We were in it, in it to stay, in it with "everything that we are and everything that we have."

"Everything that we are." What were we?

We were a nation of a hundred million souls, made up of all the races of the world, fused into a single people by the fire of a common tradition and a common love of liberty, aided by matchless resources in agriculture, industry, commerce and inter-communication for effectuating our patriotism and the common devotion to our national ideals.

"Everything that we have." What did we have?

Statistically, our national wealth was estimated at Two Hundred Billions of dollars.

Two Hundred Billions, either written out, or put in the form of a figure "2" with eleven zeros after it, conveys no picture to our mind whatsoever. It gives not the slightest hint of the million-acred wheat and corn fields stretching to the horizon; the rolling prairie and boundless plain; the rich unbounded pasture-land on which grazed countless herds of cattle and sheep; the unmeasured depths of coal and ore deposit; the far-reaching furrow, the flaming forge, the potent profusion of factory, shop and mill; and all of it tied together by upwards of 250,000 miles of railroad artery, and by a system of electrical communication embracing one-third of the world's telegraph wire, and nearly two-thirds of its telephone wire, reaching, by means of its live, pulsating network, a total of ten million telephones, or nearly three times the number possessed by all the warring nations of Europe put together.

And that is what we had.

But overtopping and transcending every material resource, was that holy zeal for the preservation of liberty which knew no limit to personal sacrifice, and was prepared for a fight to the finish in the great cause that we had now made our own.

And now that we were definitely in it, we were anxious to "wind up the job" in the shortest possible time.

For the telephone and telegraph organisations of the country, Theodore N. Vail, Chairman of the Committee on Telephones and Telegraphs, spoke in a language that but echoed the spirit of the nation as a whole:

> We are in this war. We are in it to stay. The sooner we become effective, the more help we can give, the less we will have to do, and the sooner it will be over. The more dilatory we are, the greater burden we shall have to bear. Minutes of

delay now mean days, weeks or months of waiting later. Time is the very essence of, the most potent factor in, our duty in the world war. Procrastination now might well be the thief of our success in what we have whole-heartedly set out to accomplish.

Of this magnificent spirit, no American or group of Americans had a monopoly. It was shared by all, and *all alike*. Never before this moment had the country's sons and daughters, irrespective of business or social station, so completely dissolved their differences in the sacred flame of patriotism.

CHAPTER X

THE SIGNAL RESERVE

He was applying for a position with the Food Commission. The job involved a canvass of the milling centres of the Northwest, in connection with the problem of grain distribution. Hence the colloquy which follows:

"Do you know anything about the milling business?"

"No."

"Ever had any experience with grain?"

"None whatever."

"Do you know the territory? Have you been in the Northwest?"

"No, never been west of Chicago."

"Then why do you feel qualified for this sort of work?"

Pause, followed by a sudden inspiration. "Well, you see," came the reply, "I figured it would be an advantage to approach this work with a *completely unbiased mind.*"

And that was the kind of "unbiased mind" that many of the Bell System candidates for a Signal Reserve Commission possessed, insofar as purely military routine was concerned. But in the great game of wire communication, these candidates for a commission were far from "unbiased." They were "biased" in the extreme. What these men *did* know, was how to build up, equip and run an organisation that would furnish the American Army with a system of electrical communication vaster in scope, more reliable in emergency, more per-

fect in operation, than any which had yet crossed the line of Allied or enemy vision.

But first, tape—red, red tape—had to be cut in abundant quantity, if the War Department was to utilise the services of these experts with the least possible delay. And a load of it was removed at one stroke with the following provision:

> No oral or professional examinations will be required. Candidates will submit evidence of their actual employment in civil life and references by whom they were employed or with whom they were associated. . . . Examining boards will investigate the documentary evidence submitted and may obtain additional evidence by questioning the candidates or otherwise. Upon all the evidence considered, the Board will base opinion as to the grades for which they deem the successful candidates qualified.

The decks were now cleared for action, thanks to the vision and judgment of those elements in the Regular Army who made possible, by direct, vigorous steps, the cutting away of this dangerous accumulation of red tape. But for them, there could have been no proper utilisation of the nation's magnificent resources in trained personnel.

Indeed, we are prone to forget that the part played by the Reserve Corps during the war was made possible by our splendid Regular Army nucleus, by that group upon whom devolved not only the duty of initial planning, but the colossal task as well of making soldiers, in the all-too-brief period available, of that vast body of civilians who served so effectively during the war.

And in no branch of the service was this rôle of the Regular Army more capably fulfilled than in the Signal Corps.

Which leads us to the question, Why is a Signal Corps?

When Miles Standish led his valiant little army of twelve against the Indians, he had no great need for a Signal Corps.

An encouraging pat on the back, a word or two of command, —and all the purposes of a Signal Corps had been fulfilled, so far as the commander-in-chief of that little army was concerned.

The need for a signal service in the Army, however, has existed almost from the very first days of organised battle.

Way back in ancient times, as early as 490 B.C., during the Battle of Marathon, the invading Persians raised a brightly polished shield on the summit of a mountain that overlooked the battlefield, reflecting the sun's rays to the watchers on the Persian ships. That reflection was a crude progenitor of the modern Signal Corps heliograph.

Then the system of "runners" was developed. (They were not called "runners," until the late war; they were called "couriers.")

As warfare expanded, it became more and more necessary to perfect a system of co-ordinating, by signals, the various elements making up the army in battle, so as to engage these most effectively and compactly against the foe. For one man, on the average, is pretty much like another. Men do not differ much in individual physical attainments, so far as battle is concerned, and courage is monopolised by no racial group. The thing which counts in battle is the *effective co-ordination* of the units engaged. That army which can best employ large groups against the enemy is bound to triumph in the end.

The idea of utilising electrical communication as part of the Signal Corps first arose in the mind of a young army sergeant named Meyer, who was sent with his crude apparatus on an expedition against the Navajo Indians in New Mexico, and at once demonstrated its worth. The office of Signal Corps Officer of the Army was created in June,

1860—the first of its kind—and Meyer was appointed Chief Signal Officer. When the Civil War broke out, Meyer was ordered east, and opened a school for signallers.

Right there was the beginning of the modern Signal Corps. Horses and mules were employed to carry wires back and forth across the battle area, and the tremendous advantage of this form of military co-ordination was never forgotten.

From that time on, the employment of electrical communication in warfare came to take on a decisive importance.

There were many who marvelled at Oyama's success in the Russo-Japanese War. It was due almost entirely to his excellent understanding of the strategic value of the telephone in warfare.

The German military experts were not slow in taking this lesson to heart. Neither, for that matter, were the other European powers. Before very long they had demonstrated that in modern warfare, the importance of electrical communication was paramount.

Thus in February, 1917, the question which became all important was: What was the Signal Corps of the United States Army to be?

Was it to be commensurate with all the requirements that would be imposed by modern warfare? If so, the Army had a chance of success.

Was it to fall short in any important particular? If so, the efforts of the Army fell proportionately, because upon complete unity of effort the effectiveness of the Army was greatly to depend.

We can see this now with all the clearness of hindsight. For consider: if at any time during the late war the Signal Corps had been subtracted from the American Army for the

space of a single hour, the whole military machine would have collapsed as utterly as would the human body deprived of its spinal column.

When America first entered the World War, she found herself with a Signal Corps ridiculously inadequate to the requirements imposed by modern warfare. Eleven officers and ten soldiers—that was the military personnel attached to the office of the Chief Signal Officer on March 31, 1917! The entire Signal Corps personnel on April 6, 1917, including that in the field as well as the small group at headquarters, numbered but 55 officers and 1570 men. And the Signal Corps was the organisation upon which was to depend, for the vital function of intercommunication, an army of four million men!

It was a grave situation that Squier had to meet. Would he meet it? Would this professorial type of soldier, this student-inventor who wrote highly technical papers for scientific periodicals, who addressed the foremost scientific bodies in the land—a "Ph.D. man," forsooth!—be equal to the vigorous task of building an adequate Signal System for the greatest American Army in history, while struggling, at the same time, with the enormous aircraft problem? There was frank scepticism in high military circles. They could not foresee that within the space of a score of months, the little band of twenty-one—not twice the size of Miles Standish's valiant little army of twelve—was to expand into an organisation having control over fifty-six field signal battalions, thirty-three telegraph battalions, twelve depot battalions, six training battalions, and forty service companies—embracing a personnel of 2712 officers and 53,277 men; 1462 officers and 33,038 men of whom were in France, and

the large proportion of the latter—eighty-one per cent, to be exact—at the front with combat troops.

This tremendous expansion, of course, had to come largely from the ranks of the citizen reserve. The extent to which telephone and telegraph personnel of the Signal Corps was recruited from the Bell System alone, may be seen from the fact that out of more than twenty-one thousand employees of the Bell System who served in the war emergency, 4525, or about one in every five, served under the Chief Signal Officer of the Army.

To John J. Carty falls the distinction of having been the senior Signal Reserve Corps officer in the United States Army. Commissioned senior major in the Signal Reserve Corps on January 6, 1917, he became the keystone of the Bell System arch erected by the Signal Corps. Upon him devolved the duty of building up, from the vast body of highly trained experts scattered all over the country, the organisation of officers and men who were to design, construct, maintain and operate a large part of the most remarkable telegraph and telephone network ever placed at the disposal of an army in the field. Upon the proper selection of these thousands of experts depended the success or failure of our military means of electrical communication.

Carty was the one man in a position most perfectly to effect this vital form of mobilisation. He was Senior Officer of the Signal Reserve Corps. He was Chief Engineer of the American Telephone and Telegraph Company and the foremost telephone engineer in the world. He was President of the American Institute of Electric Engineers, with a membership of nearly nine thousand, representing the leading electrical engineers of the country. And he was Chairman of the Executive Committee of the National Research Coun-

cil,—that remarkable aggregation of world-famous scientists of whom mention has already been made.

No sooner had the Signal Corps figured out its requirements in personnel, than Carty began a selective search reaching into every telephone, telegraph and electrical organisation in the United States.

He began, of course, with the Bell System. That meant that he must first secure the complete backing of the directors and officers concerned.

It happened that in November, 1916, the presidents of the various Associated Companies making up the Bell System were holding a conference at New York City, under the chairmanship of Union N. Bethell, then Senior Vice President of the American Telephone and Telegraph Company. These officers represented organisations covering every state in the Union—North, East, South and West.

Carty seized the opportunity, and laid before this nationally representative body the plans he had developed, in conjunction with the Signal Corps, for the most efficient utilisation in case of war of the Bell System plant and personnel. Said Carty:

> If war should come, we must be in a position where everything has been done that we possibly could do, to prepare for it.
>
> England, in the early stage of the war, pressed as she was for immediate drafts of fighting men to be thrust into the line at the earliest possible moment, made a terrible mistake, partly excusable, because of the pressing need, but carrying with it, nevertheless, a disastrous toll which counted heavily in her subsequent efforts. For she was forced to lift bodily out of her industrial structure a huge mass of men, trained and untrained, skilled and unskilled alike. The loss was terrific. And it imposed upon her an irreparable handicap, the extent of which she will never be able fully to calculate. What England might have done had this loss of expert personnel been avoided, no one can say.

But it is certain that she has never fully recovered from this drain.

We in this country, insofar at least as the Bell System is concerned, must see to it that we do not repeat England's mistake. We shall not make this mistake, insofar as we ourselves are concerned, if we fully co-operate with the Signal Corps in building up a trained reserve for handling the signal needs of the Army in case of war.

Our plans contemplate two classes of Signal Corps officers to be recruited from the Bell System. One of these is to consist of engineers and executives who will remain in their offices, wearing the Army uniform, representing the War Department, and taking their orders direct from Washington. Their duty will be to direct the highest possible military utilisation of the Bell System plant and personnel, without at the same time crippling the service as a whole. The other group will consist also of executives and engineers, who will select and organise the trained personnel of the Bell System into companies and battalions, for such field service as occasion may require.

I cannot, of course, take final steps in this vital programme without your support. I now ask that support. We must act as a unit.

The answer came in the form of an unqualified and enthusiastic approval of the general plan as proposed. Ultimately, it took the shape of a resolution passed by the Board of Directors of the American Telephone and Telegraph Company, and subsequently passed in substantially the same form by one Associated Company after another throughout the Bell System, providing, in substance, that, first, as to necessary absences in time of peace, employees would suffer no loss of pay, vacations, eligibility for sickness and accident benefits, or of credit for service in the matter of pensions and the like; and, second, as to necessary absences in time of war, employees would suffer no loss of pay, vacations, etc., during at least the first twelve months of absence—the question of pay beyond that period being left for further consideration.

With the entire Bell organisation back of him, Carty thus became the connecting link between the War Department, as represented by the Signal Corps, and the trained telephone and telegraph experts of the country. He was given *carte blanche*. Without that, he could have accomplished little, and it was this constant support of the responsible heads of the Bell System that gave power and effect to his subsequent efforts. "Whatever I was able to do in the Army," Carty acknowledged many months later, "would have been impossible without the authority of Theodore N. Vail, together with the co-operation and approval of Vice Presidents U. N. Bethell and N. C. Kingsbury, and of H. B. Thayer, President of the Western Electric Company. It is to these men and their associates, to the action of the Board of Directors of the American Telephone and Telegraph Company and of the Associated Bell Companies, and to the complete and hearty approval of the officers of these companies, that I owe largely whatever success has accompanied my efforts to make the Bell System count effectively in the World War."

All that now remained was to go ahead with the details of the program.

All that remained—it was enough! It was, indeed, a very delicate programme, requiring delicate handling. Nothing would have been easier than to bungle it by an indiscriminate call for candidates, and a resultant flood pouring through the narrow neck of a single office, in the shape of tens of thousands of applications upon whose hasty assessment the future of the Signal Corps and, perchance, of the entire American Army might depend for success.

The thing had to be done with the utmost discrimination; also with the utmost speed. The situation recalls the caution

of a famous surgeon to his bustling assistants, just before a critical operation: "Take your time, gentlemen, take your time—for we have no time to lose!"

On October 21, 1916, Carty wrote to the Chief Signal Officer that "it might be well to withhold the promulgation of the regulations concerning officers for the Corps until we have worked out the matter a little further with my Company here. I would like to see a plan that would set a good example to the other companies."

And the Chief Signal Officer, through Saltzman, replied:

"We are withholding in this office a certain amount of publicity concerning the Signal Officers' Reserve Corps in order that we may not be overwhelmed with applications. It would greatly please us if you would send us quite a list of prospective captains and lieutenants. If you will do so, I will have all the proper blanks sent to each man with a letter explaining them, so that all he has to do is to sign the application.

"It would be very easy to send our letters out broadcast and receive a great many applications, but we wish to do the thing properly and get the right men that you wish to recommend to us."

First came the problem of selecting the leading engineers and executives belonging to the first class described as those who were to "remain in their offices, wearing the Army uniform, representing the War Department, and taking their orders direct from Washington"; that class, in other words, which was to "direct the highest possible military utilisation of their plant and personnel."

At the head of the Western Electric Company Engineering Department—that great laboratory whence have proceeded, in conjunction with the engineers of the American Telephone

and Telegraph Company, more miracles of electrical science applied to communication than from any other similar organisation in the world—was a still comparatively young man, a former college professor, named Frank B. Jewett.

A modest, unassuming master of electrical science, with a reputation, despite his thirty-eight years, as one of the world's leading physicists, he had in 1904 left his position as teacher of physics and electrical engineering at the Massachusetts Institute of Technology, to join the greatest commercial faculty and laboratory of its kind in the world—the noteworthy assemblage of Bell engineers engaged in improving and perfecting the art of electrical communication. In 1912 he was made Assistant Chief Engineer of the Western Electric Company, in charge of development and research, and in 1916 became Chief Engineer of that organisation.

Upon Carty's suggestion, approved by the Signal Corps, Jewett applied for a commission as major, in order that he, in turn, might "direct the highest possible military utilisation of the plant and personnel" subject to his direction.

It will be interesting, at this point, to quote the orders Jewett received when called to active service:

> In view of the fact that the present war depends more than ever before on the efficiency of electrical communications of all kinds between each of the elements of the United States forces, both on land and sea, your duties will be primarily to keep constantly in mind any improvements in apparatus and methods of the means used in transmitting communications; to produce, develop and standardise such apparatus as may seem promising from time to time; and in general to advise and counsel the Chief Signal Officer of the Army in all matters tending to bring the Signal Service of the Army to the highest state of efficiency.

To say that these orders were carried out, would be like describing Niagara as a "large body of water falling over a

precipice." For at the very time he received these orders, Jewett and his remarkable organisation were already busy on a most amazing variety of experiments and inventions which, long before the war was over, were to startle the civilised world. Properly told, they would form in themselves one of the most dramatic stories of human achievement ever recorded.

Jewett, having entered the military fold, was now called upon, in turn, for a careful selection from his own organisation of candidates to serve as his junior officers; and the result was a new accession to the Signal Corps of such brilliant young men as Craft, Shreeve, Buckley, Slaughter, McGrath, and a notable group of other officers who were to serve as capstones to the respective technical structures which they reared to the common cause.

Carty did not confine his efforts to the Bell System alone. In close and constant touch with the Signal Corps,—acting, in fact, virtually as part of the Signal Corps even in advance of being commissioned senior reserve officer, Carty arranged for the selection and commissioning of representative personnel in the Western Union Telegraph Company, the Postal Telegraph Company, the independent telephone companies—every existing agency of electrical communication that the country had to offer. Then, reaching out and beyond these agencies, Carty began feeling out the personnel situation throughout the entire electrical field represented by such nation-wide organisations as the National Electric Light Association and other prominent electrical organisations throughout the country.

He was "missing no bets." With painstaking care and thoroughness, casting about in every direction, commanding the loyal co-operation of every executive in the country who

was directing his own particular individual "sector" of the greatest network of electrical communication in the world—Carty weighed and balanced each requirement set forth by the Signal Corps as the latter unfolded its plans, and endeavored to obtain, in each instance, a perfect fit for every foundation stone of the great edifice which was about to be erected.

CHAPTER XI

BELL BATTALIONS

It was an eager crowd indeed that responded to the call for volunteers in the Signal Enlisted Reserve Corps, posted in the main and branch offices of the Bell organizations throughout the country.

And it was a case of "many were called, but few were chosen"; for wide was the gap between the number needed and the number that applied. Out of 6000 male employees of The Bell Telephone Company of Pennsylvania, many of whom were beyond military age, 1400 applied for 200 vacancies for enlistment. Up in the Mountain States, the Bell Company required 100 enlistments, and four and a half times that number answered the call. Out on the Pacific coast nearly 1000 applications were received within a few weeks, to fill a quota less than one-fourth that number. From 3650 male employees in the Northwestern Bell Group came 974 applications for 209 places, or nearly five times the number required. And so it was in every other Bell organization throughout the country.

The result was no small amount of rivalry, and poorly concealed chagrin on the part of the rejected majority.

"Look at him puff out his chest!" exclaimed one disappointed candidate. "Think you're hell, don't you? Suppose you're going to bean the Kaiser with a bar?"

"Naw," was the proud and disdainful rejoinder. "Just going to pull his moustache off with a pair of pliers."

The wide margin to pick from, however, meant a highly refined process of sifting that spoke well for the final result. It permitted the most careful choice of men on the basis not merely of personal calibre, training and special qualifications, but also with a view to freedom from family obligations, and the all-important question as to whether they could safely be spared from the organisation without endangering the essential fabric of telephone service at home.

The first concern, however, in the formation of these "hand-picked" units, was to get the right kind of officers.

Saltzman, representing the Chief Signal Officer, had made up for Carty's guidance a preliminary estimate of the first year's requirements in officers and men. Carty promptly drew up a table in statistical form of the geographical distribution of employees by various associated company groups throughout the Bell System.

Here was a compass to steer by.

Carty forwarded a letter to each of the company heads, outlining the plan so far developed, and designating the allotment expected from each associated company group.

There began at once a searching process on the part of each company head for the most available officer timber. No examining board could have functioned more thoroughly, and certainly none could have possessed a more intimate knowledge of the candidates' qualifications, than did these company officials who were co-operating with Carty and the Signal Corps virtually as semi-official examining boards.

One after another the nominations came in, each nomination made only after the most careful canvass of the entire field; so that when, finally, it had passed up along the line and reached the stage of direct application on the official Signal Corps blank, nothing remained in the way of an

examination that could add to the factors already weighed in the balance.

When General Squier observed that never was a more competent or finer lot of officers incorporated into any army, he was no more indulging in polite rhetoric than was General Pershing when, in turn, he declared some two years later that "The Signal Corps in France stands out as one of the masterful accomplishments of the A. E. F."

The officers having been selected, there came the call for volunteers and the resulting rush to "get in with the gang."

And what a "gang!"

Cable splicers, linemen, switchboard men, clerks, operators, installers, telegraph operators, test men, helpers, truck drivers, motorcycle drivers, mechanics,—each man trained for years in his own particular job, and each ready to bet his hat that there was no other man in the world that could beat him at his own game.

Never have I seen such "pride in the outfit" as prevailed in these battalions of wire experts. It was not confined to the men themselves. Every battalion commander was everlastingly certain that there was no other battalion in the Signal Corps quite like his.

In the summer of 1919, at a gathering of former Bell Battalion commanders, I asked each of these veterans privately the same question: "Just between ourselves, and all bias aside, which of the battalions do you think distinguished itself for most remarkable service?"

It was a foolish question, and I might have known it. The whispered answer confided to my ear was virtually the same in each case: "Of course, the ———— and ———— Battalions were a mighty competent lot, and did a wonderful

job, but candidly, and, I think, impartially, my own outfit naturally had it on the rest, because ————."

And they were not all young men, either,—using the army standard of youth,—although, of course, young blood predominated. If you looked carefully through this picked "gang" of volunteers, you found a liberal sprinkling of men in their late thirties and sunny forties, men with families, men who simply couldn't and wouldn't stay out, men whose mature telephone experience the country was fortunate indeed to obtain, who were able to devote those services to their country by virtue of the assurance that their respective Bell organisations would take up the financial slack between the old payroll and the new one.

But alas for the ruthless requirements of army life! Carefully picked as these men were, there were some who could not by the wildest stretch of imagination contrive a happy adaptation of past to present.

For example, the cooks.

Now cooks, irrespective of rank, are important—as any army veteran, and many a lifelong civilian, will lugubriously but emphatically agree. But bucking reels, climbing poles and splicing wire,—splendid experience though they furnish for Signal Corps war requirements, are woefully lacking in opportunities for culinary training.

This sad fact confronted Bud Leary,[1] of the Northwestern Bell.

Bud was selected as cook because, as the adjutant later explained, "He looked as if he could take a special interest in food." Bud immediately quit his telephone job, landed a job in a Duluth restaurant, and took a course of intensive

[1] The incidents mentioned in this and succeeding chapters are based on facts, but true names are not in all cases given, for obvious reasons.

training in the School of Ham and Eggs. Greater devotion than this hath no man.

And then there was the case of Fred Kniffen, a New Yorker who boasted inherited qualifications, being the son of a butcher. He urged this fact earnestly and effectively. It was the only way he could get into the battalion—his special telephone training suffered eclipse in competition with his fellows. And so Fred was selected on the strength of heredity. How far heredity justified itself in this instance will forever baffle the psychologist; for although Kniffen ultimately attained the proud and well-fed eminence of a mess sergeant, it is difficult to determine whether this flowering was of the blood, or due to months of voluntary K. P. training at Fort Wood.

And the blacksmiths—no battalion organisation was complete without them.

"How," I asked one battalion adjutant, "did you make your selection of blacksmiths on the basis of telephone experience?"

"By guess and by God," he replied. "We would look the crowd over, pick out a husky six-footer, call him a blacksmith, and by the sacred ring of his hammer, a blacksmith he was, for he never failed to make good."

Considered in the light of subsequent events, the speed with which these battalions were recruited—all within the space of a few weeks—is almost incredible. It is a tribute not only to the prompt and patriotic response of the Bell volunteers, and the smooth working of the entire organisation from top to bottom, but also, and in no small measure, to the splendid calibre of the Department Signal Officers on duty at the time, and their effective co-operation in each

instance. The Regular Army Signal Corps was most fortunately represented in this vital phase of its development.

"But what are the boys going to do?"

A group of operators have foregathered in the "rest room" during one of the intervals of relief, and of course this topic has no chance of escape until a pardonable degree of feminine curiosity has had its fill.

"I understand," one of them volunteers, "that they wave flags at the enemy to signal them that they're beaten."

"Wouldn't the enemy know they're beaten without the flags?" shrewdly interpolates another.

"Not if they're ignorant Germans!" is the patriotic rejoinder.

"Oh, that isn't it at all"—this from one evidently in the know, and not to be questioned—"The men are going to build telephone and telegraph lines for the Army in case of war, and for the Signal Reserve Corps in case of peace. The whole thing is under Mr. Carty, who's Chief Master Signal Electrician, and the battalion officers, who are commissioned sergeant-majors. I know, because I saw it in one of the booklets the Company got out and sent around to the men. Besides, a—a friend who's in it explained it all to me."

Well, if the conception of these girls was a trifle vague as to just what the Telegraph Battalions were for, the large majority of the men themselves had no very definite notion of their future conduct in the kingdom of Mars, outside of a keen eagerness to get under way, and a clearly defined yearning to pry a bayonet, at the earliest possible date, into the tender portion of a German abdomen.

It was not until these men had tasted the rigours of intensive training—and in some cases not until they were

actually at it on the soil of France—that they learned what they were really expected to do.

Speaking broadly, the Signal Corps job is to construct, maintain and operate means of communication for the Army, these means, to-day, being largely telegraph, radio and more especially telephone.

There are two types of Signal Corps units assigned to this job.

One is the Telegraph Battalion.

The other is the Field Signal Battalion.

There are two parts to every army: the front, and the rear.

Every unit at the front must be connected to every other unit at the front.

Every unit in the rear must be connected to every other unit in the rear.

And both front and rear must be connected to each other.

Now it goes without saying that an army can have no front unless it first has a rear; unless, in other words, it is first provided with a general headquarters, a base of operations, a base of supplies.

And therefore, before you can have any fighting at all, you must first have a base of electrical communication.

Consider the country as a whole as the soil from which the tree of military activity derives its sustenance. Consider the roots as the bases of supply. Consider the heart of the trunk as general headquarters, the trunk itself as the army zone, the main branches as army corps, and the limbs as army divisions.

And there you have the area within which the Telegraph Battalion is supposed to function.

A number of Telegraph Battalions are first assigned to the

construction and maintenance of lines of communication for the Service of Supply.

Then, where these battalions leave off, two other Telegraph Battalions assigned to each army zone pick up the lines of communication and carry them forward as far as corps headquarters, connecting up, at the same time, the various corps headquarters within the army zone. There they stop.

To each corps within the army zone, an additional Telegraph Battalion is assigned, and this battalion, picking up the lines of communication at corps headquarters, where the army Telegraph Battalions leave off, carries them forward to divisional headquarters, and connects up, at the same time, the various divisional headquarters within the corps area.

It is at this point that the function of the Telegraph Battalion is supposed to stop, and that of the Field Signal Battalion to begin.

I say "supposed," because as a matter of fact, as it subsequently transpired in actual combat, especially after St. Mihiel when rapid movement became the order of the day, the difference between these two kinds of battalions frequently resolved itself, in the heat of the campaign, into a difference between Tweedledee and Tweedledum. Both became the popular offspring of Mother Necessity. Both forgot what the books said they should do, and did what had to be done under existing circumstances—often within machine-gun distance of the enemy.

However, according to the books, the Field Signal Battalions begin where the Telegraph Battalions leave off. That is to say, they begin at divisional headquarters, carrying the lines forward from there on to the very "front of the front." And there is nothing lady-like in these operations.

Such, roughly, are the functions of the Telegraph Battalions and the Field Signal Battalions. Now as to their organisation.

At the head of the Telegraph Battalion is a major, known to the men as the "K. O.," alias "C. O.," alias Commanding Officer. His duties are obvious. He is the boss of the battalion's job.

Assisting him, is the battalion adjutant—a first lieutenant whose duties, according to one of them, are "to know everything, do everything and stop at nothing" in all matters relating to the battalion.

The Commanding Officer and the Adjutant, together with an acting Sergeant-Major and a number of orderlies and drivers, make up what is known as the Headquarters Detachment of the Battalion.

Then there is the Supply Detachment, headed by the Supply Officer, usually a first lieutenant.

Finally, there is the Company, of which there are two in each Telegraph Battalion. Each Company is made up of four "sections"—two telegraph and two telephone sections. A captain heads the Company, and two first lieutenants complete its officer personnel. One hundred enlisted men make up the soldier personnel of the Company: 2 signal electricians, 7 sergeants, first class, 11 sergeants, 17 corporals, 2 cooks, 1 horseshoer, 48 privates, first class, and 12 privates ("no class at all—just privates," as Private McGinnis observes.)

A Telegraph Battalion thus comprises a total of 10 officers and 209 men,—when it is completely organised.

N. B. A Telegraph Battalion is never "completely organised"—not at least during the course of active operations.

The make-up of a Field Signal Battalion is a trifle more complicated. This is due, no doubt, to the wider range of its functions, not the least of which is to string and repair and splice all kinds of wire while lying on your stomach and keeping your head and your hair and your dinner all down at one and the same time.

As already explained, the Field Signal troops, to facilitate tactical operations, are expected to furnish communication on the front line in combat, from divisional headquarters forward.

One Field Signal Battalion is assigned to each division. Others are assigned to each corps and each army, but these are only for reserve purposes, inasmuch as they are not supposed to be employed except in the presence of the enemy—real or assumed.

The Field Signal Battalion, embracing a total personnel of 14 officers and 459 men, consists, besides a Headquarters and a Supply Detachment, of three companies: a Radio Company, a Wire Company, and an Outpost Company.

The first unit of the Field Signal Battalion is the Radio Company, designated as "Company A."

The Radio Company is used by the commander of a division for maintaining communication with adjacent columns, with divisional cavalry, and for all purposes generally where distance, the character of the service and the nature of the terrain prevent the laying of wires. Sometimes it serves to connect divisional headquarters with divisional trains. Sometimes, pending construction of semi-permanent lines by the Telegraph Battalion from corps to divisional headquarters, the Radio Company serves to connect division and corps headquarters. And sometimes—ofttimes—it is used to inter-

cept enemy messages or "bawl up" the operations of enemy radio stations. But "more of this anon," for it is a story in itself.

The second unit of the Field Signal Battalion is Company B, the Wire Company, used in the field to connect up to division headquarters not only the various brigade headquarters within the division, but also the divisional artillery, and, in some cases, the divisional trains.

Each Wire Company is divided into four wire sections. If you are a member of one of these sections, your life is just "one damn twisted pair after another," provided you can get the "twisted pair." Otherwise you construct, in fair weather and foul—usually foul—an endless succession of grounded circuits, by fastening the wire to branches of trees, bushes, fence posts, hoofs of dead horses, or anything else that happens to be handy—you have neither time nor inclination to be particular. If roads are to be crossed, and overhead facilities have been shot away, you simply lay your wire on the ground with plenty of slack and a fervent prayer to the Almighty.

The slack is to prevent the wire from being easily broken by traffic. The prayer is that the Lord Almighty divert traffic in another direction.

The slack and the prayer are usually unavailing, which means a return to the scene of operations, renewal of slack and prayer, and a never-failing accompaniment of rain—from the clouds, the enemy, or both.

To this line, when constructed, is attached a "buzzer," operated by a member of the Wire Company. The buzzer is a portable instrument which may be used as a telephone, if it happens to be kindly disposed, or for sending customary



U. S. Official

GENERAL JOHN J. PERSHING



U. S. Official

MAJOR-GENERAL GEORGE O. SQUIER

Morse or International Morse code signals by telegraph, if telephone transmission is impossible.[1]

These telegraphic signals are received in distant transmitters in the form of a high-pitched hum, reminding you, as one observer has put it, of "a giant mosquito singing to its young."

Last, but most certainly not the least, there is the Outpost Company, known as Company C, also known as "The Suicide Club."

And here is what U. S. Army Regulations say of the Outpost Company's job: "Uninterrupted communications between the units, despite all conditions, is the goal to be striven for, and the subaltern who attains it will have found that he has solved a problem more difficult than that which usually confronts far higher commanders."

The function of the Outpost Company is to extend the lines of communication from the point where the Wire Company leaves off, namely, forward of the brigade, furnishing communication between the infantry brigade commander and his regimental commanders in combat.

Sounds simple enough, doesn't it?

I doubt if there is a more trying or heroic job in the entire scale of army operations. During an engagement, the men in the Outpost Company average approximately twenty-four hours per day in realising the full force of Sherman's classic characterisation. The balance of their time, according to regulations, they may be called upon "to supplement the work of the other Companies of the Field Signal Battalion wherever it may be necessary or desirable."

[1] The use of the army buzzer in France was condemned, during the latter phases of the struggle, for a reason which will appear in a subsequent chapter.

The so-called Bell Battalions, twelve in number, were Telegraph Battalions, not Field Signal Battalions. At least that is what they were intended to be, until the conventional rules of trench warfare gave way to a wide-open, free-for-all, mix-up with the enemy.

In addition to these twelve Telegraph Battalions, the Bell System furnished two Radio Companies. One of these, Company A of the 314th Field Signal Battalion, was recruited from the Hawthorne Works of the Western Electric Company, and the other, Company A of the 319th Field Signal Battalion, from the Engineering Laboratories of the Western Electric Company in New York City. Finally, a portion of an Outpost Company for the 301st Field Signal Battalion was recruited from the Southern New England Telephone Company (Connecticut).

These were the Signal Corps units furnished by the Bell System *en bloc,* but they are by no means the total score. There was scarcely a Telegraph or Field Signal Battalion organised after our entry into the war that did not contain a liberal sprinkling of officers and men from the Bell System throughout the United States. And naturally. Trained wire experts were of the essence of the job.

CHAPTER XII

BORN: A. E. F.

I

On April 6, 1917, the United States declared a state of war with Germany.

Within an hour the whole country, practically, knew it.

But it was more than a month before the country *realised* it.

During this interval, we thought about it, to be sure, we talked about it,—no matter what topic of conversation arose, it merged into the subject of war,—but we did not *realise* it. That is, we did not see it as it was.

And so, a good deal more than a little perplexed, we asked ourselves, "What are we going to do? Are we to fight a purely defensive war? Are we to confine our military efforts to speeding up supplies for the Allies, to expanding our manufacture of munitions, to financial assistance, to the strengthening of our fortifications and the consolidation of our coast defence—or just what are we going to do?

And then came the French and British missions. "They told us of a situation," said Secretary of War Baker, "which we had not up to that time fully appreciated." [1] It suddenly flashed upon the American people, upon the Administration,

[1] Testimony before the Senate Committee on Military Affairs, as reported in the Official Bulletin, January 29, 1918, p. 28.

upon the War Department, that a decisive campaign was under way on the other side, that if we did not begin to get ready for that campaign at once, we might have to give up the idea of Allied success; that if we were going to count at all, we must begin *right now.*

Once the American people fully realised this situation, there was no longer any question as to what the United States was going to do.

The United States was going to *fight.*

Not fight through the medium of cash; not fight through mute, inglorious mountains of munitions, or the worthy but insubstantial weapon of "moral support."

These, to be sure were all-important, these must be forthcoming, these must be furnished without stint and in ever-increasing volume.

But they were not enough.

Not an American, in the true sense of the term, but immediately saw, and felt, that the United States of America must fight with *men,* with men who carried guns, with men who went over the top along with the stout-hearted poilu and the doggèd Tommy; with men commensurate in number to the millions of Americans who stood ready to offer their lives, if need be, in defence of the cause we had now made our own.

II

Out of this realisation came into existence the A. E. F., which may be said to have been born on May 14, 1917.

On this day John J. Pershing was called from his station down on the Mexican border, and placed in command of the overseas forces.

Pershing lost no time in selecting his staff, and, it may be added parenthetically, he made few mistakes in the process of selection.

Consequently when the General, casting about for a Chief Signal Officer, pointed his finger in the direction of the Southern Department and designated its Department Signal Officer for the post in question, those familiar with Pershing's unerring instinct in selecting the right people for the right job, might have been justified in concluding that the A. E. F. was to have a Chief Signal Officer equal in breadth of vision and force of character to the unique and unprecedented requirements of that position.

The officer thus chosen was Colonel—later Brigadier General—Edgar Russel, a quiet, soldierly, gentle-spoken man, who was never known to raise his voice, and who always kept a motto hanging on the wall directly behind his desk—a motto which he successfully wrote into the daily lives of all those who have under his direction: *"There is no Place in the Signal Corps for the Man Who Makes Friction."*

Russel reported on May 17th, three days after Pershing's appointment was announced.

Arrived at Washington, he was advised: "You have eleven days to prepare. May 28th is the day of embarkation."

It was a jolt.

To frame an emergency estimate of the general conditions to be met, for a campaign to be waged three thousand miles away, on a scale which promised to exceed anything of its kind in history, to map out the programme of supplies involved, to determine the problem of sufficient and suitable personnel—all in eleven days!

"We will have to get busy," murmured Russel, gently.

But there was nothing gentle in the way he got busy.

III

Three main problems clamoured for solution. First, Programme. What was to be the main field of American operations in France, and what would be the corresponding requirements of the Signal Corps?

Second, Supplies. What supplies would be needed, where and how could they be obtained so that work on them could start at once, and proceed to a timely delivery?

Third, Personnel. What immediate assistants should Russel select to accompany him on this initial expedition, and what further personnel would be available for a proper organisation and execution of the job?

First, as to Programme, let General Russel tell his own story:

> The day after our arrival in Washington, May 18th, we learned that the probable American sector would be on the right of the main French forces.
>
> A railroad map of France was immediately procured and studied. Assuming our location as just stated, it was apparent that of the ports controlled by the Americans, Brest, St. Nazaire and Bordeaux must be our chief reliance.
>
> The main axis of our system, therefore, must begin at St. Nazaire and extend eastward along the Loire Valley, and not too far northward into the main French activities.
>
> This led us naturally to Nantes, Tours, Bourges, Dijon, and—keeping still in the valley region—Is-sur-Tille, Langres and Neufchâteau.
>
> An auxiliary axis running north and south would have to cut athwart this main axis running east and west: from Bourges or Nevers southward to Bordeaux, and from Tours northward to Paris, thence on to Havre on the north coast.

This was the famous "400-Mile Line," with its 265-mile extension, that before very long many a telephone and tele-

graph engineer in this country was to toil on by day and dream of by night.

And this was the great spinal column for the marvellous network of electrical communication erected by the A. E. F. Signal Corps.

It now remained to determine the question of supply.

At this juncture Major James W. Hubbell, commanding the 1st Reserve, or 406th Telegraph Battalion, of the Bell Telephone Company of Pennsylvania, was called to Washington.

"I hadn't the slightest idea what was up," said Hubbell, "but as soon as I had reported at the Chief Signal Office in Washington, I was led into a private office where, on a wall, hung a large map of France, decorated by two rows of coloured pins crossing each other. Colonel Russel was standing there in front of the map in a rapt, thoughtful sort of way, as if contemplating what lay behind those pins.

"He turned around immediately, and I had no sooner introduced myself than he began, 'Hubbell, here is the proposed axis of communication in France. It is to be a line 400 miles in length, with a 265-mile auxiliary axis. Your telephone company, I understand, is accustomed to building just such lines as this one, and that is why you have been called for. I want you to study it, and let me have a list of the tools, apparatus and equipment necessary.' "

Saying which, Russel put on his hat and made his way out to lunch.

"And by the way," Russel added, as he paused on his way out—there was just the suspicion of a twinkle in his eye—"if you can let me have that list by the time I have returned from lunch, so much the better."

Hubbell took the hint. For all of two nights and a day,

the Engineering Department of The Bell Telephone Company of Pennsylvania worked away at the details in the preparation of a general requisition for all the materials and tools that would be required in conjunction with the projected network of communication insofar as it could possibly be estimated.

At the end of the second day, Hubbell presented the proposed requisition at Washington.

It was immediately approved.

"And," said General Russel, nearly three years later, "in the light of subsequent experience, it may be said that the requisition would not need a ten per cent revision."

IV

The day for departure drew near. Russel, in his quiet, unobtrusive, but deadly effective way, was "omitting no word or deed," before leaving, that might have a vital bearing upon the future of the American army in France insofar as its communication needs were concerned.

Consequently, a few days before the day set for sailing, one of the most important conferences in the history of the American Signal Corps took place, at 195 Broadway, New York City.

The result of this conference may not inappropriately be termed The Crossing of the War Wires Rubicon.

It determined the entire American programme of electrical communication in France.

And that—for a nation recognised as temperamentally the most voracious telephone consumer in the world—is but another way of saying that it determined, to a large degree,

the speed, effectiveness and entire course of our military operations in France.

The conferees were Colonel Edgar Russel and Major John J. Carty.

The problem presented by Colonel Russel was this:

"Very remarkable results have been obtained in America with the new apparatus and methods recently developed for long-distance telephony and telegraphy. But these methods and this apparatus are of such recent origin—so scientific and complicated and delicate in their working—that the propriety of specifying them for use in the theatre of war presents a grave problem for decision. They have given good results in the United States. But those results were obtained under conditions where they were under the care of large numbers of well-trained, scientific personnel; where repair parts, renewals, shop experts and manufacturing resources of all kinds were immediately available. None of these favourable conditions exist in Europe. In fact, so new are the methods and apparatus, that they are not even known to the European nations. And, finally, this is war: the strain imposed upon the signalling systems will present obstacles never encountered during commercial operations."

It was a poser. After all, would it not be better to play safe; to stick to the conservative, tried-and-true methods of wire communication now employed in the army?

And what were they?

They were, first, the "army buzzer," adaptable either to telegraph signalling or telephone transmission; second, the old Morse key telegraph, and third, the every-day, bread-and-butter telephone.

The army buzzer was styled "the pet of the American army." It was, really, a very remarkable and admirable

instrument. It had become, quite rightfully, the chief source of Signal Corps reliance, and——

Germany knew it, and was laying her plans accordingly. The buzzer proved one of the easiest things in the world to "listen in" on. Germany found no difficulty at all in picking up its most secret messages. And it was precisely for this reason that the use of the army buzzer in France was subsequently condemned by the Commander-in-Chief of the American forces.

But with the army buzzer under a cloud, what was left as a source of reliance in electrical communication?—Nothing but the old Morse key, and straight-out telephony along orthodox lines of construction and operation.

"It won't do," said Carty. "Americans will want to fight exactly the way they do business: on the straight and shortest line between two points. They must therefore have free and unlimited access to telephone and telegraph facilities. They must have telephone service on the *American,* and not on the European scale. We have devices that will permit many messages to pass simultaneously over a single pair of wires. This will mean, to be sure, highly complicated apparatus and highly trained personnel. *But it will also mean a tremendous saving in shipments,* for it will eliminate thousands of poles and untold tonnage in wires and equipment."

Step by step, Carty unfolded the technical details involved in the daring scheme of transplanting to French soil, across a three thousand-mile barrier of submarine-infested water, a complete, modern, up-to-the-last-minute American telephone and telegraph system.

There was, first, the matter of substituting, for the heaviest gauge of copper telephone wire, known as "No. 8's" (165 mills in diameter), wire of half the weight in copper per

mile of line. It meant a tremendous saving in tonnage. But it had another aspect, which revealed itself later in startling form when one of our telephone engineers, surveying the type of French poles available for the Americans, exclaimed, "My God! What an assortment of *bean poles!* How in time could we ever have strung enough No. 8's on those things?" And the answer was, *They couldn't have done it.* The poles would have collapsed.[1]

Then there was the question of the *Repeater* versus the *Loading Coil.* To the layman, this means nothing. To the European governments, this meant nothing, too. To the expert telephone technician, it means a great deal.

The *Loading Coil* is a metallic box one and a half feet cube, very heavy, closely resembling, in appearance, the ordinary transformer on an electric light pole. This box contains a special coil which neutralises, to a great degree, the "electrical static capacity" in the line—hence tremendously improves transmission of the human voice.

The *Repeater* is a mechanism one foot square and about seven feet high, which *regenerates the telephone conversation.* It consists principally of an electric valve, through which the current flows in such a way that every wave formation in it—meaning, for the present purpose, the human voice—is amplified and reproduced with absolute fidelity and carried along the line. It is this quality which is responsible for the wonderful improvement in telephone transmission at long distances on circuits equipped with *Repeaters.*[2]

[1] These poles, of course, were necessarily the "left-overs" available to the American Army, the better poles in France having been used up during the devastating three years preceding.

[2] The following incident was related to the author by Lieutenant-Colonel Hubbell, commanding the 406th Telegraph Battalion:

At Autigny-le-Tour, where the headquarters of the R. A. F. was located, the British leased an American line operated through Neuf-

Now, the *Loading Coil* is a highly desirable thing, but, to be effective, it must be installed in the line at *intervals of approximately eight miles,* and must be mounted on the pole, subject, therefore, to line trouble, and not under the direct supervision of the maintenance man; whereas *Repeaters* are installed only at *intervals of one hundred to one hundred and fifty miles,* not mounted on poles, but installed *in offices,* and therefore under the direct and constant supervision of the maintenance man.

There could be no question as to which was preferable for war use in France.

The *Repeater* was new, to be sure: but it was *the thing* for the war emergency.

And then there were the newly developed American devices for getting the most out of every pair of wires, by means of the *simplex, composite, duplex, multiplex* and *phantom.*

As everyone familiar with the rudiments of electricity knows, there are two kinds of circuits: metallic, consisting of two wires, and grounded, consisting of one wire, with the "return" flowing through the earth.

A *simplex* is merely a combination of one grounded telegraph circuit with one metallic telephone circuit.

To *composite,* you go just one step further, and get two

château and Chaumont to a point north of Paris, running from there on to London over the British circuit. The British commanding officer at that point had occasion to use the line to the British War Office in London. It was the first time he had ever talked over an American circuit equipped with repeaters.

"Would you believe it?" he later reported his amazement to an American officer. "They actually recognised my voice in London before I told them who I was!"

"Yes?" the American officer responded, politely but uncomprehendingly. And to himself: "Wonder what he sees remarkable about that?" Accustomed to the constant use of repeater circuits, he was at a loss to account for the British officer's surprise.

grounded telegraph circuits from one metallic telephone circuit.

"Milk and steak from the same cow," as one army officer put it.

Duplex means that you take either of the above obtained types of telegraph circuits (*simplex* or *composite*), and arrange it so that two messages can be sent simultaneously over any one circuit—one message in each direction.

Multiplex goes still further. The ends of the above *duplex* are rotated in exact synchronism between two or more printing telegraph machines. Result: a capacity for handling telegraph traffic which well-nigh staggers the imagination. By the use of the multiplex printing telegraph, as it subsequently transpired in France, six telegraph messages were sent simultaneously over a single wire, and that wire was at the same time being used as a part of two different telephone circuits. One multiplex printing telegraph, working 24 hours a day, can handle enough messages a year to eat up, at the rate of merely one copy to a message, a pile of paper which would reach as high as the Woolworth Tower.

A *phantom* is an extra telephone circuit obtained by utilising two existing metallic circuits in such a way as to obtain a third circuit without any additional line wires: a "ghost" of a circuit—a spirit hovering between the wires—that talks as well as any other in the metallic flesh, so to speak.

"And if I catch any of that junk coming in on the other side," was the remark of one regular army officer, "I'll kick it off the dock!"

There was much to be said in favour of this position. In war, you incline to resolve every doubt in favour of an established certainty.

These telephone and telegraph devices were unquestionably

ingenious, but they looked like "high-brow stuff." Would they work under the rigorous conditions of warfare?

Carty was by no means serenely confident. In his mind, too, there was enough of a doubt to suggest the horrifying consequences, if all these elaborate refinements, roughly jarred and jolted by the stress and strain of war, should result in a fizzle.

But if Carty felt the gravity of this responsibility, how about Russel? To him was entrusted the immediate responsibility and ultimate destiny of the entire Signal Corps in France.

Russel possessed the one outstanding quality of a splendid executive. He *saw* his job: not in administrative concepts, but in *actual things*. As was said of him later by one of his own subordinates: [1]

> He saw the American-built-and-operated telephone and telegraph lines stretching across France, a constant reminder of home to all who followed their paths along the country roads, or glimpsed them from the passing trains. He saw the men of the Lost Battalion, besieged in the dank undergrowth of the Argonne, releasing their last pigeon with silent prayer for its safe homing flight. He saw the doughboys in the fox-holes on the Meuse telephoning back for the barrage that would drop its protecting curtain between them and the counter-attacking Boche. And he saw the organisation that was to make possible assured, continuous and immediate communications wherever there were Americans.

And so Russel gave the order to go ahead.

The die was cast, the War Wires Rubicon crossed.

Carty had committed himself—he had committed the Chief Signal Officer of the A. E. F.—he had committed the American army and the whole American nation, to one of the most daring American ventures of the entire war.

[1] Carroll O. Bickelhaupt, Major, Signal Corps, U. S. A., of the American Telephone and Telegraph Company.

Nothing now remained but to "make good."

This meant not only that "the stuff had to get over," but that an entire army by itself of highly skilled technicians, thoroughly trained and thoroughly acquainted with these specialised, last-minute devices, had to be forthcoming, or the entire fabric would fall to the ground.

And this explains why Carty, during the months that followed, from his excellent vantage ground as mobiliser of the trained electrical personnel of the country, devoted such painstaking and minute care to the selection of each candidate, be he major or private, called for by General Russel on the other side of the water.

V

Let us anticipate for a moment.

Some two years and eight months later, in January, 1920, Colonel Carty was testifying before the House Committee on military affairs, and during the course of his testimony, made the following remarks:[1]

> There had been preparations made for war in the European terrain for 40 years. When the war broke it was not possible for any of the European nations to provide a communication system adequate for the conduct of the war. It remained for the Signal Corps of the United States Army in nine months to construct a long-distance telegraph and telephone system which the governments of Europe had failed to do in 40 years. We did that in nine months. There was a wire from Rome to Paris a great deal bigger than the wire we talk on from Washington to San Francisco, but they could not talk over it. It became very important, in order to talk, to make those communications better, and we sent some of the Signal Corps officers into Italy, and they literally made Rome howl, because the talk from Rome came in so strong at Paris.

[1] From Mr. Carty's Testimony Before the Committee on Military Affairs, House of Representatives, on Army Reorganization, Signal Corps, January 28, 1920, Page 2047.

The Signal Corps built a system extending from Marseilles on the south to Le Havre on the north, and across the Channel to London, and equipped a line on to Liverpool; on the west their lines went as far as Brest, and on the east as far as Germany. We were able to talk all over the Continent. That gives you an idea of some of the work done by methods absolutely unknown to any of the nations engaged in the combat.

And then consider this exhibition of sublime confidence—or colossal nerve—whichever way you look at it:

"Our plans for these lines and the design originally called for a degree of transmission which would give satisfactory talk to Berlin."

With the Russian bear on his back and the heel of the Hun in the pit of his stomach; with the entire Italian Army disastrously routed in that terrific Austro-German drive just ended; with the British hammering away futilely at Paschendale Ridge and their morale oozing out with every vain attack; with the French practically at the limit of their exhaustion; with tremendous German hordes being transferred from the eastern to the western theatre of war, and the campaign of 1918 looming ahead as an appalling possibility of enemy success; with Allied bottoms vanishing beneath the waves at the fearful rate of a million tons a month,—we have this magnificent bit of American audacity, this sheer challenge flung in the face of an apparently adverse fate, this plan of a "satisfactory talk to Berlin!"

That talk to Berlin came sooner than expected.

It was "satisfactory talk" indeed!

VI

And thus did Russel, during the brief interval immediately preceding his departure overseas, lay the initial foun-

dation stones affecting programme and supply in the upbuilding of the A. E. F. Signal Corps.

There remained the all-important question of personnel.

No one has described the personnel situation as it existed at the time, better than General Russel himself:

A preliminary review of the personnel situation was not very encouraging. At the time of the passage of the National Defence Act of 1916 the Signal Corps consisted of 1212 men and 42 officers. This mere handful was scattered all over the world, about half being occupied in the installation, maintenance and operation of telephone systems, the Alaskan cable and administrative work. The other half were organised into field and telephone companies. Eighteen states had organised field Signal Companies averaging only about fifty members each, and sixteen of these companies had seen some service on the border in 1916. Many of them had been hastily organised with miscellaneous personnel, and in the short time available for training could not hope to gain more than the rudiments of a Signal Corps education. In fact, between measles and mumps for the men and glanders for the horses, the actual field training was generally futile. No National Guard telegraph companies were organised. The difficult situation existing at the end of 1916 up to the time of the immediate threat of war, must be recited to give a just appreciation of our problems. The field company as an organisation had existed only five years, the telegraph company but two years. Only eight months before, the revolutionary order had come prescribing a field battalion of the now well-known Radio, Wire and Outpost companies, and a telegraph battalion of two companies, and among the regular Signal Corps troops two field battalions and two telegraph battalions had been organised. With such utterly inadequate numbers and untried organisation for a nucleus the Signal Corps saw the vast conflict impending.

The hopeful element of this difficult situation came, however, through the National Defence Act of 1916 in providing for the Reserve Officers and Enlisted Men of the Signal Corps. The Signal Corps was one of the earliest to appreciate the advantages to be gained in the Reserves, by organising the large number of excellent technicians to be found in the great electrical industries of the country. The leading telephone companies were the first

to respond, led by the wise and patriotic action of the parent company in making liberal provisions for the personnel that volunteered. By the end of 1916 some of the leading telephone and telegraph engineers of this country had become Reserve Officers of the Signal Corps, and telegraph battalions consisting of skilled technical men were well on their way to organisation. While the average of military training in these units was small, their intelligence, enthusiasm and willingness to learn made them assets of tremendous value. When war was declared and they came to the training camps our Signal Corps instructors quickly appreciated the high class personnel thus assembled. Twelve telegraph battalions of 202 men each, with a full complement of officers, came to us from this source, and four battalions from the railway telegraph organisations. We shall later trace the influence of these battalions on the great wire system that grew up in France.

And then there was the question of the personnel that Russel was to take with him on that memorable first convoy.

While Hubbell, of the First Reserve, or 406th Telegraph Battalion, was in Washington, he suggested that inasmuch as his battalion was soon to be called upon for active service in France, it might be well to have some of its representatives precede the main body, so that much of the preliminary survey work might be completed, and actual construction begun, immediately upon the arrival of the Battalion.

It was a good idea. But General Pershing had rigidly limited the number of persons allowed on the first convoy, and Colonel Russel despaired of enlarging the list he had already made up.

It therefore came as a surprise when two officers of the 406th Battalion and its acting sergeant-major received orders to report at Governor's Island on May 27th, prepared to accompany the Pershing convoy.

The officers thus chosen were 1st Lieutenant William F. Repp, a man with 17 years' experience with The Bell Telephone Company of Pennsylvania, 1st Lieutenant Rexford

M. Glaspey, transmission engineer of this Company, and Sergeant William E. Quinby.

It was a fortunate selection, for these men were, strictly speaking, the only "telephone men" in Russel's party, and but for their preliminary pioneering on the telephone network in France, much valuable time might have been lost in getting under way.

Repp ultimately attained the rank of Lieutenant-Colonel, Glaspey, at the time of his unfortunate death in France, was a Major, and Quinby, after acting as interpreter for General Pershing's staff and for the Chief Signal Officer in negotiating with the French for leasing the first group of lines for the Americans, was later commissioned and assigned to the Intelligence Section of the General Staff, returning to America as a First Lieutenant.

"Just before we sailed," relates General Russel, "we managed to get aboard the equipment for a large headquarters telephone central, which subsequently saved us a very embarrassing situation due to the delay in arrival of such supplies."

This equipment, as a matter of fact, consisted of two units known as the No. 4 Western Electric P. B. X.s, secured on 48-hour notice by "stealing" or "diverting" from another rush order at the Western Electric Company's plant at Hawthorne, near Chicago.

Listed as "handbaggage," these units were immediately rushed East over the Lake Shore Limited, which handles passenger service only.

At the same time, about 25 or 30 poles were located at a loading point in Pennsylvania, piled into cars, and hooked on to a New York passenger express, arriving about the same time with the switchboard units.

A Western Electric agent promptly piled all the equipment into trucks and, under the mysterious "Follow me!" of an army officer, rolled up West Street with his retinue of trucks, and with a sigh of relief watched the equipment disappear in the hold of the *Baltic.*

It was a fortunate bit of foresight. The central office set up with this equipment at American army headquarters in France did yeoman service during those anxious months when the A. E. F. Signal Corps scanned the horizon in vain for incoming telephone and telegraph supplies.

On May 28, 1917, the great ocean liner, the *Baltic,* steamed out of New York harbour, carrying the vanguard of a prodigious column two million strong, who before many months were to cross the selfsame briny bridge and write their names into history for all time.

CHAPTER XIII

A. E. F. BEGINNINGS

Had you stood in front of Nos. 27-31 Rue de Constantine, Paris, on the morning of June 14th, the day after General Pershing arrived in Paris, you would have heard the familiar clicking of typewriters and the busy ringing of telephones, indicating a considerable amount of activity within. You might have suspected that these first headquarters of the American Expeditionary Forces had been established there for several months instead of for several hours. Even the generous Marquis himself, whose mansion was being thus utilised, would have had difficulty in recognising his former abode.

Had you made your way still further, to the interior of these headquarters, past the wiry U. S. Regulars guarding the huge doors, you would have found General Pershing and his staff hard at it, laying the broad foundations for an army whose size and growth scarcely a soul could then have suspected.

In what became known as the Code Room at 31 Rue de Constantine, temporary offices were assigned to General Pershing's Chief Signal Officer, Colonel Russel, pending more permanent quarters for the Signal Office established five days later at No. 64 Rue de la Boite. To Russel was delegated the task of building up a system of communications

which, in very truth, was to spell the success or failure of America's effort in France.

One after another the main problems involved in this vital undertaking began to stand out in Russel's mind.

There was, first, the problem of maintaining a constant, uninterrupted flow of communication across the Atlantic with the chief base of operations. When it is remembered that the American Army fought three thousand miles from its home base, and that the tremendous flow of men and supplies from the United States to the distant firing line hung by a few slender threads of electrical communication to the directive centre at Washington, the gravity of this problem will be appreciated. That enemy submarines threatened these communications in a very real way, will be seen in a subsequent chapter. Russel, before sailing on the *Baltic*, had consulted Carty in the matter; and ultimately it was Carty to whom the Chief Signal Officer of the United States turned when the matter became increasingly grave. Not only was complete continuity of transatlantic communication vital to military operations, but it was obvious that any additional use of these facilities whereby members of the A. E. F. might communicate with their relatives and friends back home, was bound to have an important and telling effect on the morale both "over here" and "over there." It was for this reason that Russel, barely three days after he got to work in Paris, made the welcome announcement of E. F. M.—Expeditionary Force Message—cable service, available to members of the A. E. F. at reduced rates.

Then there was the problem of procuring, with the least possible delay, signal equipment suited to immediate field requirements. In this, as in other respects, Russel had an abiding sense of the importance of seizing time by the fore-

lock. The *Baltic* had landed at Liverpool on June 8th, whence Pershing and his party had proceeded to London for a five days' stay. During those five days, Russel and his staff were quietly investing their time in a careful inspection of English signal equipment, special telephone and telegraph designs for war uses, and the latest technical developments in the field. And they were frankly amazed at the complex, novel and ingenious devices that the war had produced. Later, Russel relates, upon arriving in France and visiting the French front, "a similar series of surprises were in store for us. If anything, the French had exceeded the English in the magnitude and variety of their achievements. This was especially so in radio telegraphy and its kindred devices. It quickly became obvious that much of this material could not be developed and produced soon enough in the United States to be of service to the American troops coming to France, for at least six months. While having full faith in our ultimate production of just as good or better instruments, it was decided then and there to depend upon France and England for such production in the U. S. until the new patterns had been approved after actual field tests in France."

There was, however, one greater surprise still in store for General Russel in the field of communication. That was—the system he was to build up himself. He did not then realise—it is doubtful if anyone then fully realised—the tremendous reservoir of latent resource and power stored up in America.

We were considerably behindhand, to be sure, in matters affecting immediate military operations. This was our handicap: the price of preparing at the eleventh hour. In some cases we overcame the handicap almost immediately. In others, the time was too short, and the Armistice arrived

before the handicap could be fully overtaken. But in all cases, the length of time it took to adapt equipment to immediate war requirements depended upon this: Was there, or was there not, a well developed organisation in that particular field prior to our entry into the war?

Radio telegraphy and the air service furnish two of the less fortunate illustrations, although, everything considered, it is surprising that we made the progress we did with these technical branches during the war. In neither case, however, was our backwardness national, so much as it was organisational.

In radio, for example, we had no commercial organisation comparable to the great commercial organisations of Europe, for we had made radio largely a government affair, a matter of bureaucracy rather than business. And so with the airplane, our backwardness was due solely to the lack of a preexisting organisation for its development on any sizable scale. The airplane, to be sure, was born in this country. But since its use was primarily military, its development necessarily depended upon governmental interest and encouragement; and our government turned its back on the stripling. Had the United States Government manifested the same interest in the airplane as had the British, French or German Governments, or had the airplane been a straight-out commercial matter,—there cannot be the slightest question as to whether our airplane programme would have fully come up to every expectation. American business enterprise would have attended to that.

The telephone, too, was born in this country. But from the start its development was commercial. A large, well-developed national organisation grew up, typical in every respect of American business method, and the result was a

development, in proportion to population, twelve times that of Europe.

So it was with a justifiable amount of confidence that Russel, with thousands of trained wire experts to call upon back home, with a system of electrical communication in back of him incomparably vaster than any other in the world, set about the task of building up a wire network for the A. E. F. adequate to its needs.

But first of all, whatever the ultimate plan might be, it was necessary to arrange for the utilisation of immediately available equipment and facilities. A considerable amount of such equipment would necessarily have to be obtained from French and British sources. That would mean an adequately trained force of expert inspectors. However, provision must simultaneously be made to adapt, with a minimum loss of time, the American resources in electrical communication to the last-minute, front-line standard.

An organisation to accomplish both these ends was suggested by Russel's study of the elaborate research and inspection laboratories in London and Paris, and hence the origin of the Research and Inspection Division of the A. E. F. Signal Corps, whose birth may be said to date from two communications written by Russel on June 20, 1917, six days after he got to work in Paris. One of these was the official recommendation to General Pershing concerning the new organisation; the other was a personal communication to Carty, back in the States, outlining the purpose and needs of the Research and Inspection Division, and requesting suggestions.

Equally immediate was the problem of furnishing telephone service at the newly established General Headquarters,

and for the arriving units forming the vanguard of the American Army.

For what American headquarters, military or otherwise, considers itself ready for business until it is equipped with telephone service?

There was Pershing's headquarters in Paris; the headquarters of the Signal Corps; a newly established general base of supplies at Nevers; a medical base of supplies at Cosne; a hospital to be opened at Dijon; the headquarters of the 15th Engineers located at Vierzon; and the headquarters of the First Division, shortly to locate at Gondrecourt.

But how provide telephone service to these headquarters, when you had, as yet, no telephones, no wires, no switchboards,—nothing except the large plans for the future?

The natural solution would seem to be, "Connect up with the French under lease."

The solution was not so simple. Conferences with the French authorities soon made that clear. The spirit was willing, but the French wire system was weak; not merely because it was inadequate on the basis of American standards, but because the French lines were already being worked to their full capacity, and they were desperately short of operating personnel.

The French offered to do what they could. They managed to scrape together a number of small private branch exchanges from somewhere, and these Repp, of The Bell Telephone Company of Pennsylvania, with the aid of thirteen soldiers gleaned from various arms of the service already in France, managed to install within six days after the survey was made.

Then there was the immediate necessity for telegraph service to connect up the various advance units of the American

Army, particularly the newly established supply base at Nevers, to General Headquarters. On August 9, 1917, the Signal Corps opened a telegraph office at the Hotel Mediterranee, Paris, connecting with a Signal Corps telegraph office at Nevers by a circuit leased from the French, and using French instruments.

This was the first telegraph line operated by the American Signal Corps in Europe.

Another line, from Paris to the headquarters of the First Division at Gondrecourt, was put into operation about a week later.

But it became clearer than ever that the American Army would have to provide its own telephone and telegraph system, and that in the quickest possible time. The arrival of the first two Bell Telegraph Battalions was expected in August. All preliminary arrangements must be pushed with the utmost vigour, so that these battalions could get to work as soon as they arrived.

With the true instinct of a student of strategy General Russel, when told in Washington that the probable American sector would be on the right of the main French forces, had plotted out the general direction of his main line of communications. It would run, he figured, from the base port at St. Nazaire, to the rear of the combat zone in the Gondrecourt area, with general field headquarters, most likely, at Chaumont. His forecast was absolutely correct. It now remained to plot out the route in detail of the main axis of his telephone and telegraph net, and this he left to his able assistants, Captain R. B. Paddock, whom Russel had put in charge of his engineering division, together with Repp and Glaspey.

These officers virtually lived in an automobile for ten

consecutive days, going over every foot of the different roads along the main route, carefully calculating, exactly as they would have done back home, the transportation, warehousing, manufacturing and commercial facilities in each of the numerous towns through which they passed, and making up scientific estimates of the probable amount of telephone service, local and long-distance, and of telegraph service, that would be required at the points in question.

As a result, it was decided to build a standard American line, capable of handling joint telephone and telegraph traffic. The poles were to be equipped with cross-arms along which ten wires could be strung, from which the experts of the Bell System would be able, by utilising their scientific methods for multiplex telegraphy and telephony, to squeeze-out many times that number of telephone and telegraph circuits.

The line was to run from Gondrecourt to Neufchâteau, thence to Chaumont, where Pershing was shortly to locate his General Headquarters, thence through Langres, Dijon and Beaune to Nevers, where the general base of A. E. F. supplies was located; thence through Bourges to Tours, where the headquarters of the Service of Supply was to be finally located, and from there on through Angers and Nantes to the base port at St. Nazaire.

This was the backbone and beginning of the Signal Corps network in France.

At the very start, however, a serious difficulty was encountered, and had to be overcome before a single line could be built.

That difficulty was—poles. The French supply had almost reached the vanishing point—thanks to three years of devastation. True, 40,000 poles had been ordered back in

Washington, but the tonnage situation made them unavailable for indefinite months to come. General Russel, with the aid of the Western Electric Company, had smuggled 25 or 30 poles on board the *Baltic* before he sailed, but 25 or 30 poles won't go very far in building a trans-France telephone line. The French officials of the Administration des Postes and Telegraphes simply threw up their hands when the subject of poles was broached to them. *Mon Dieu!* there was not a pole to be had in all France. They were in dire need of poles themselves.

How it was done is still a mystery, but Repp finally succeeded in wheedling 5000 poles from the Directeur des Postes and Telegraphes, together with some 25 tons of bronze wire,—the latter being absolutely unobtainable in the open market. After several days of strenuous shopping among the merchants of Paris, a further supply of 80,000 lbs. of iron wire was rounded up, and—

Russel and his handful of pioneers were now ready, after a fashion, for the two Bell Telegraph Battalions shortly expected to arrive from the United States.

CHAPTER XIV

SPOON, SHOVEL, BAR AND—BRASS

Ask any former member of the 407th (New York) Telegraph Battalion whether or not Dijon is "Somewhere in France," and if he is not quick-tempered and violent, he will look at you suspiciously for a moment, and then demand, "Who told *you* about that?"

And thereby hangs, not only a tale, but a taunting sort of a tale.

While the first two Bell Telegraph Battalions were at the St. Nazaire "rest camp," awaiting orders to duty, the Battalion Adjutant of the 407th was instructed by a very emphatic and profane major in the regulars on the importance of mail censorship. The young man was duly impressed. He imparted the instructions to his battalion with all the emphasis and some of the profanity used by the gifted major. For the major had left him in a perfect spasm of terror as to the consequences if any of the men should by some oversight, happen to mention that they were alive and well, or similar information of possible strategic value to the enemy.

For weeks following, the battalion correspondence might have been described as "the quintessence of crypticism." Letters were short, and about as specific as a campaign speech to a constituency of unknown sentiment. And of course each letter was properly headed, "Somewhere in France."

The battalion was ordered to Dijon, whence the first batch

of battalion mail was dispatched homeward via the French post-office,—there being no American post-office in Dijon at that early date.

In due course, the men heard from home in response to their letters. They were horrified. The home mail bristled with such solicitous inquiries as, "How do you like Dijon?" "Dijon is quite a city, isn't it?" and "Are Dijon girls pretty?"

Inquiries cleared the mystery. The French post-office had simply put its stamp on all outgoing mail.

Immediately upon the arrival at St. Nazarie of the 406th Telegraph Battalion, from The Bell Telephone Company of Pennsylvania, and the 407th Telegraph Battalion, from the New York Telephone Company, the commanding officers of these two battalions reported in person to Colonel Russel, for definite plans and orders on the proposed construction.

"We tried to report to you by telephone soon after arrival," said Hubbell to his chief, "but——"

"Yes, I know," smiled the Colonel. "And that's why we're here—to make it possible to do that all over the A. E. F."

The plans were for the 406th to take station at Chaumont and the 407th at Dijon. Both battalions were to work their way in a northerly direction, the 407th from Dijon to Chaumont, and the 406th from Chaumont to Neufchâteau. The pole line all the way from Dijon to Neufchâteau was to be constructed for an ultimate "30 wire lead," in telephone parlance, with one pair of copper wire, temporarily, between these two points, two pairs of iron wire between Neufchâteau and Gondrecourt (the latter to be constructed by the Second Field Signal Battalion, stationed with the First Division at Gondrecourt,) and an additional pair leased

from the French between Dijon and the artillery school and camp at Valdahon. Thus, with switching points at Chaumont, Dijon and Neufchâteau, the most important points of communication necessary at that time were provided for.

But first, an important job awaited execution at Chaumont. General Pershing was moving his headquarters from Paris to this point, the change to be effective on September 1, 1917. Everything had to be ready by this date—and the telephone was everything to the intrepid commander-in-chief of the A. E. F.

And here it was that Russel thanked a benign Providence for his foresight in smuggling the two Western Electric switchboard units into the hold of the *Baltic* before he sailed for France. For these units now permitted the installation of a two-position, 200 line, "honest-to-God" American switchboard at the new General Headquarters of the A. E. F.

This installation job was assigned to a detachment of 50 men from the 406th Battalion, under Lieutenant, later Major William F. Gauss, a Pittsburg Bell man, with Pittsburg ideas of building "quick, rough and ready."

Gauss received his orders on August 23d, arrived at Chaumont with his detachment, after two days and two nights in the crowded compartments of an antediluvian coach, on Saturday, began work the following morning—such was the Sabbath ever in the A. E. F.—and five days later had the switchboard and 100 telephones in full working order.

Six cities claimed the honour of Homer's birthplace. More than that number of Signal Corps organisations claim the honour of erecting the first poles on the soil of France. It appears that the six poles set by these men from the 406th Telegraph Battalion for distribution of telephone—and electric light—wires around the Chaumont headquarters, during



BRIGADIER-GENERAL EDGAR RUSSEL

General Pershing's Chief Signal Officer, at the head of the Signal Corps in the A. E. F. throughout the entire war.



TYPE OF CLIMBERS USED BY THE FRENCH

Variously referred to by American linemen as "ice tongs," "crab claws," etc.

the last week of August, 1917, were really the first to be erected by the American Signal Corps in France.

As already hinted, it was not merely a telephone job. It was necessary, in addition, to install telegraph equipment, and also a power plant in the Caserne Lambert, General Pershing's immediate headquarters. One detail of the 406th was assigned to the installation of the switchboard, another to placing the sub-station wiring in the three large buildings which, together with several smaller ones, formed the barracks, and a third to the installation of the power plant. Telegraph service to Paris was established over a wire obtained from the French, and two men from the detachment were assigned to its operation.

Such were the beginnings of the Signal Corps in Chaumont, ultimately to develop into a humming centre of activity comparable, in size and number of messages handled, with the largest office in France.

Students of medieval architecture may descant upon the grand solidity of French masonry; but the men on this wiring detail, who had to make all drillings with the lightest and flimsiest of tools borrowed from the French, saw nothing elevating about the job.

While these gangs were testing the hardness of French masonry, another and more fortunate group was installing telephone and electric lights in the chateau opposite, to be occupied by General Pershing. I say "more fortunate," because during this installation, one of the men detected a loose board in the cellar floor which, upon investigation, proved to be part of an extensive camouflage system designed to conceal a large store of wine. To whom this wine belonged was never ascertained. The men who made the discovery are known to have been unusually popular for a considerable

period thereafter. It is not a matter of history, however, whether or not General Pershing had this fabulous store of rare beverage removed, upon taking up his quarters immediately above the bacchanalian cellar.

During the installation of telephones at the barracks, it became necessary, since there was no underground connection, to swing a 150-foot span of heavy aerial cable between two of the buildings. It may seem strange, but this was a nine-day wonder to the French. Two men from Company E of the 406th, Russell and McAnnallen by name,—former Bell cable experts,—made up, by hand, a length of aerial suspension strand from No. 6 wire, and from this hung the heavy French underground cable.

The French signal officers were simply aghast at such audacity in construction. They were certain it couldn't possibly hold.

It held to such good purpose, that Russell was sent to Paris to instruct the French telephone men in aerial cable construction. Special tools were required for this work. None were available. No such tools were known in France, and no American signal supplies had yet arrived. Russell, nothing daunted, drew up sketches for the tools required, supervised their manufacture, and went ahead with the business of initiating the French into the mysteries of this branch of American telephone practice.

This was the first of what one battalion adjutant defined as "a long series of depredations by the authorities,"—i.e., drafts on expert personnel detached from the field organisations for special duty at headquarters or elsewhere. "From that time on, the progress of the battalion resembled that of an overloaded wagon with the horse running away. Every time the wheels went round, some men dropped off." The

Chief Robber of Personnel, as he was thought of by the battalion officers, was a headquarters officer, who happened to be a Bell man with a "damnably accurate" fund of information as to where the expert Bell personnel lay. But it was all, of course, "for the good of the cause," and the battalion leaders got what comfort they could out of that.

Several days after the Chaumont installation, the two telegraph battalions got to work on the Dijon-Neufchâteau line. Utterly without adequate tools or supplies, except the inferior equipment begged, borrowed or stolen from the French,—and the French, be it said, "came across" in generous fashion during those early days,—the battalions found it a heart-breaking and back-breaking task.

Behold the construction crews of the 406th, engaged on the line from Chaumont to Neufchâteau. The ground is literally "sewn to rock," which you quickly encounter in almost every pole-hole started. The soft steel of the French digging bar is simply no match for the rock, as the raw and blistered hands of the men eloquently testified. And the French shovels—!

"Who ever named *thim things* shovels?" asks McReady, in righteous Hibernian indignation—McReady who recalls, with disgust, the advertisement to which he had capitulated, "Wanted, 5000 telegraphers for the Army."

"Tiligraphers is it that they wanted? Who ever heard of tiligraphing with a child's toy shovel fastened to the ind of a broom handle?" It is well that McReady, glaring down on the object of his scorn, restrains his desire to step on it with his hobnailed shoes, for if he did, he would buckle it up like a biscuit tin. The best he can do is to yearn for a good old-fashioned American shovel.

Callahan, of E Company, has the same feeling of disgust; but his contempt is expressed in loftier terms, and is broader than McReady's, extending to all forms of digging tools and post holes, without regard to make, kind, or previous condition of servitude. Two years before, he was a candidate for Congress on an 8-hour platform. His present views on the subject of working days running from 12 to 14 hours, rain or shine, and devoted exclusively to drilling holes into unyielding rock, completely eclipse, in expressiveness, his previous campaign utterances on the subject of labour. But he works along cheerfully and steadily, just the same.

The newly improvised "shop forces" of the battalions are kept constantly busy on the never-ending task of sharpening digging bars and repairing the French shovels and "spoons." They have another job, and a very artistic one, i.e., making linemen's spurs.

For the American lineman, after several heroic efforts to use the French climbing irons, has given it up in disgust. The French climbers—"ice tongs," as the American lineman calls them—closely resemble the curved section of a crab's claw. It is almost suicidal for a lineman to attempt to walk two or three steps in them.

The French lineman never tries it. In climbing a pole, he takes only the shortest of steps, and feels secure only when the hook attached to each foot more than half encircles the pole with its toothed edges. After descending a pole, he lights a cigarette, and leisurely removes the hooks. Then he carries them to the next pole. By this time it is necessary to light another cigarette; which, done, he dons the paraphernalia anew, and makes his leisurely ascent up the next pole.

The American lineman puts on his spurs when he starts

work in the morning, and keeps them on until he has finished his work.

A thoughtful lineman has smuggled a pair of American spurs into France, along with his trench mirror and shaving utensils. It proves a godsend. The battalion supply officer forthwith rents a blacksmith shop, and sets four of his men to work making spurs. At the same time, he commandeers a saddle shop, and with a Chinaman's patience, teaches the woman in charge how to make leather straps for improvised spurs.

No sooner are a number of these straps completed, than the eagle-eyed supply officer makes haste to claim them. *Mais non!* He cannot take them from the shop until they are paid for. *C'est impossible!*

What to do? The battalion supply officer has used up all his cash in buying large stocks of shovels, hatchets and other tools: he simply *must* have the straps—

He bundles them under his arm and starts down the street. A large, irate French woman, protesting loudly and volubly, follows; the usual crowd quickly gathers; but the officer manages to *"pas compris"* his way back to the waiting linemen, who promptly put them on and go to work.

And then the resentful feminine saddler witnesses a sight to behold. She rubs her eyes. With mouth wide open in dumb amazement, she beholds an American lineman, apparently without spurs at all—except those insignificant things she has been working on—swiftly ascend a pole with the agility of a monkey, and, with the aid of one arm, almost *stand out at right angles to the pole!*

She shakes her head. "Those crazy Americans—what will they do next?"

Doubtful whether these mad, pole-climbing demons will

ever pay her, she turns sadly away. She is later mollified not only by payment in full, but by an extra premium for the strain an her nerves.

Back at headquarters, a new job developed. "Business" was rapidly growing between American General Headquarters and the various French lines, necessitating an underground cable between the American headquarters and the French exchange.

"Another damn detail to bust up our nine," remarked the captain of the battalion baseball team.

Erstwhile telephone construction men, central office men, telegraph operators and other experts wearied their backs and tongues plying French tools in building the rocky trench. By dint of "pure beef," as the sergeant in charge of the detail put it, they got the trench built.

When the battalion experts came to inspect the job, they were horrified. The cable had been laid without any conduit, the only protection being a light layer of large broken stones placed immediately around the cable before the trench was filled in.

How could you lay a conduit when you had no conduit to lay?

"The army," observed one of these cable experts, as he sadly contemplated the job, "is a cold-blooded proposition."

It was a mademoiselle, rather than obdurate rock, that furnished the chief obstacle to building this trench. She sat daily in front of a house past which the trench led, smiling sweetly upon the perspiring workers. Naturally, their minds were not on the trench. Discipline fought vainly against the smiles of the mademoiselle. Finally the wily sergeant, more of a strategist than a disciplinarian, approached

the Lorelei with his most confidential air, and, summoning all his French, explained that these men in their blue denims were prisoners, and inclined to be dangerous.

From that point on, the job progressed to a rapid conclusion.

The mademoiselles, however, were not always a hindrance. Crafty members of the battalion, with mending to do, sagaciously postponed that delicate task to Sundays. Had you carefully observed them on these Sabbath days, you would have found them lying in wait, like fishermen with their nets, until they spied attractive visitors wandering toward the camp. With the speed of lightning they would disappear, and presently reappear armed with their "housewives"—the gifts of Bell Telephone girls back home. The mademoiselles would do the rest.

But alas! all good things come to an end. This one came to an abrupt close shortly after Private Sam Halliday's overcoat, subjected to this pleasing branch of interallied aid, was returned to him neatly folded, with a guilty smile which Halliday understood only too well the next day, when he unfolded his coat and found two buttons missing!

Americans are not the only souvenir hunters.

The route for the Dijon-Neufchâteau line, as indicated in a previous chapter, had been tentatively selected by Paddock, Repp and Glaspey; and permission had been obtained from the authorities to place poles along the roads, across bridges, through towns, etc., on the American plan of construction. But before actual construction began, the details of the route had to be studied, and, where it was necessary to place poles on private property, formal consent of the property owners had to be obtained.

On one of these "route studies" immediately preceding construction, the battalion commander and his associates approached one of those typical French villages which, at a distance, project their solitary steeples and their one or two red spires into the early morning sunlight, resplendent against a background of fleecy cloud and azure blue.

"Picturesque, I call it," remarked one of the party.

They entered the village to confer with the mayor on rights of way across the neighbouring fields.

At once the illusion of a fairy village was dispelled. There was but a single street, on either side of which was a solid row of decrepit concrete dwellings, barns, stables and chicken-coops. In front of each dwelling, instead of an attractive garden, was that never-failing Dun's and Bradstreet's of the French villager,—the ill-smelling manure pile.

"Picturesque, I call it," echoed a disgusted member of the party, turning to the officer who first expressed the sentiment.

Later, the mayor confided that this was one of the newer villages of France, the town being just a little over a hundred years old; but he understood neither the look of amazement which greeted this bit of information, nor the confidential aside which followed: "That bird is stringing us. The town is a blamed sight older than that. It couldn't possibly have accumulated all that dirt and filth in a hundred years!"

But the mayor proved his point. The different property owners of the village were assembled, the usual formalities and introductions complied with, and then the mayor produced the town maps, beautifully engraved, and protected by rich morocco covers.

The first maps failed to show the main highway from Chaumont to Neufchâteau.

"Ah," surmised the astute mayor, "perhaps it is that these maps, they are too old. We will consult the new map."

The "new" map was brought forth. It turned out to be an artistically engraved affair—dated 1819!

The earlier maps had been made in the 18th century, long before Napoleon laid out that splendid system of Routes Nationale which are the pride of France.

Permissions were arranged, and the conference ended in glasses of *myrrh,*—that home distilled brew of fermented plums, usually a quarter of a century old, "containing"—in the opinion of one of the officers—"at least 101% alcohol, and making your head feel like a pincushion with each individual hair a separate pin."

The route was finally selected, a miscellaneous assortment of tools purchased, and the wire that Repp had secured from the French, pending the arrival of American supplies, received; and with one battalion (minus) of eager and willing men, two 1½-ton trucks, two motorcycles and one Ford touring car, the construction of the line from Chaumont to Neufchâteau was begun. To deliver all the men to their work, to have mess on hand at noon, to return the men to camp, to fetch the poles from a point a dozen or two kilometers away, and distribute them along the road,—these two lone trucks were kept constantly on the go from six in the morning till long after dark.

And the motor mechanics, with sadly inadequate tools, performed prodigies in the way of keeping these trucks in shape despite their terrific use.

The Yankee boy is a natural born mechanic. Add Necessity, the reputed maternal ancestor of Invention, and there are no limits to what he can do with a jacknife and a piece of string. These motor mechanics were no exception.

Back in St. Nazaire, while the two battalions were awaiting assignment to station, five men from the 406th were detached and sent to a nearby motor park to assemble motor cycles and trucks. (We will call it a "motor park" by courtesy alone, for it was a mere lot, without any shelter whatsoever, into which had been dumped an assortment of motors as they were taken from the boats.) No tools were provided, other than those in the kits accompanying the machines, yet when it was time for the battalions to pull out, these men had put together three trucks and a motorcycle, and set out with the first piece of motor equipment drawn by the Signal Corps in the A. E. F.

The 407th Battalion obtained similar equipment, and a notable train of fifty-six assorted vehicles for both battalions headed by Lieutenant, later Captain, Chrisman, Supply Officer of the 407th, who was himself driving a touring car, started their journey overland to Chaumont and Dijon, the respective destinations of the 406th and 407th.

To the simple-minded peasantry of the country through which this train passed, such an entourage could mean nothing less than a General.

In town after town the word went round that General *Pairshang,* the great American Commander-in-Chief, was passing through, and—touching token of American democracy—he was driving a car himself!

The poor, bewildered Supply Officer found himself the recipient of much unsought attention. How he ever got the trucks through is a mystery.

Before the arrival of this transportation at Dijon, a still greater wonder came to light. Three lone soldiers turned up at camp, claiming to be members of the 407th.

The Battalion Adjutant had never seen them before.

"We were assigned to the battalion too late to catch the boat," they explained.

"But how in the name of time did you manage to get here by yourselves?" the Adjutant inquired.

Nothing could be simpler.

These three musketeers, upon arriving at the dock and learning that their battalion had sailed, went over to Governor's Island and reported their plight to an officer. The officer, a Second Lieutenant, told them that they had better join their battalion at once; and this, being good soldiers, they proceeded to do.

Without anything remotely resembling a military order, they crossed the ocean, landed in England, crossed the channel and made their way clear across France to Dijon—all on the potent breath of a Second Lieutenant.

And yet there are those who belittle the golden bar!

Transportation having arrived, the 407th got busy on its Dijon-Chaumont line. D Company moved up to Prauthoy, where they got their first taste of the billeting system.

"Not so bad," murmured Captain Mastin, the company commander, when he was assigned to a suite that a major-general was later glad to get.

They were the first American troops in town, and the honest townsfolk "went the limit" to make the visitors welcome.

In the meantime, E Company of the 407th was having its troubles. Lieutenant Hill, with a detail of men, was sent to Camp Valdahon to install a fire control system for the artillery school and camp located there. He was nearly finished with the job when General Peyton C. March, at that time camp commandant, saw him in the mess hall.

"Who is that officer?" the General inquired of his aide. The aide told him.

Developments ensued. The General called Hill up "on the carpet" for not making a formal call on the post commandant when he reported at a post.

"I thought it was a social custom, sir," was Hill's defence, and could be omitted in war time."

The defence didn't get very far with the General. Hill got off with a reminder to make his call, next time. It is now his proudest boast that he has been called down by the Chief of Staff of the United States Army.

From the battalion commanders down, intense rivalry exists between the 406th and 407th.

"Of course," observes Shearer, commanding the 407th, to Hubbell, commanding the 406th, "I appreciate the handicap of home environment. So many of your men come from Philadelphia, and the powers that be ought to be charitable in expecting speed from your outfit."

"Charity," Hubbell drily reminds Shearer, "begins at home. New Yorkers are so busy making a loud noise, they haven't time to think what the noise is all about. Now *my* idea of speed is associated with something swift and quiet. For instance—the way my men are pushing their job."

"If you want to see line construction *as is* line construction," retorts Shearer, "come over and see my bunch pitch into it. We expect to be in Chaumont just about the time your gangs are well started out of it."

"All right, then," says Hubbell. An idea strikes him. "I'll tell you what: I'll bet you a dinner we get to Neufchâteau before you get to Chaumont."

"You're on! And to make it appropriate, we'll make it a snail dinner, loser to furnish the snails, of which, naturally,

he will have a plentiful supply—exactly the number in his battalion."

To the uninitiated, this may seem like an impossible wager. But snails—*escargoe*—are among the choicest of French delicacies—as you will discover for yourself if you can overcome your prejudice against their appearance.

So the battalions push on, despite their handicaps in inferior tools and equipment. They have learned how to get along with these, to some extent at least. But they have never overcome their contempt for "cheddite."

"Cheddite," be it known, is the explosive used by the French engineers. When the "cheddite" first arrived, the French were extremely careful to warn of its tremendous power and treachery. Only those most experienced in the use of dynamite were taken for the first trial.

Eagerly a hole was drilled in the rock and the charge placed. The fuse was lighted. Everyone retreated to a comfortable hundred yards and with bated breath, awaited the terrible detonation.

Pff! Clack!

"Old timers" characterise the explosion which followed as a poor second to that of a small firecracker which little Jimmie sets off on the Fourth of July.

Before the day was over, fairly successful pole holes were being blown with charges ranging from four to six times the maximum charge which the French advised it would be safe to use.

When the American dynamite finally arrived, "it became a real pleasure," according to Steve, of the 406th, "to blow holes."

Steadily and surely, without let-up, by dint of pegging away in all kinds of weather, the lines from Dijon to Chau-

mont and from Chaumont to Neufchâteau forged ahead to completion.

Now as to the snail dinner.

It never came off,—just why, it is not known for certain. But the author, in an effort to be impartial, submits the following facts.

The official historian of the 407th Telegraph Battalion reports the line from Dijon to Chaumont as "the first complete American line in France.

The official historian of the 406th records the following:

"This first trunk line of approximately 1400 sections (i.e., from Chaumont to Neufchâteau) was tested through about ten o'clock on the evening of September twenty-seventh (1917). Shortly afterward, the line which the Second Field Signal Battalion of the First Division had constructed between Neufchateau and the headquarters of the division at Gondrecourt, was hooked up with the Chaumont-Neufchâteau line, and became the first American trunk between general headquarters and the training headquarters of a division. . . .

"The 406th Battalion, having completed its Neufchâteau trunk and its switchboard installation, planned immediately to build south with one company (in the direction of Dijon), while Company D was engaged in wiring the various training areas, pending the arrival of more divisions. The 406th Battalion finally met the 407th Battalion some 25 kilometers south of Chaumont.

CHAPTER XV

RUSSEL AND CARTY, UN-LTD.

During the hurly-burly of those precious days when we were trying to make up for years of lost time, it was difficult enough for one branch of the War Department to keep in touch with another located in the same city, or even in the same building.

It was infinitely more difficult, as those who encountered the difficulty will readily agree, for associated organisations to keep in touch with each other when separated by the wide expanse of the Atlantic—three thousand miles across, and strewn with sub-sea engines of destruction.

And yet it is doubtful whether throughout the entire war there were two men separated by this wide barrier who kept more closely and constantly in touch with each other, than General Russel and Colonel Carty.

It will be recalled that just a day before Russel's departure for overseas, a very important conference took place in Colonel Carty's office. This conference determined the whole character of the A. E. F. communication system. It was then and there decided by General Russel virtually to transplant to French soil a complete up-to-date commercial telephone and telegraph system, in every respect equipped with the most modern devices known to the art of electrical communication in the United States.

But this decision meant that every possible resource neces-

sary to make good this ambitious and daring scheme, would have to be forthcoming without stint or hindrance—Burnam wood would have to come to Dunsinane—the Bell Telephone System itself would have to cross the Atlantic, in the person of its engineers and specialists—or the whole thing would fall through, would forever after be stigmatised as the most tragic and colossal "highbrow" failure of the entire war. It *must* go through.

It was only because Russel relied implicitly on the ability of Carty, representing the Bell System, to back up the scheme with the necessary personnel and resources, that he finally made his decision to "go the whole hog." But this confidence imposed a corresponding obligation on Carty and his colleagues to back Russel up to the limit.

That conference between Russel and Carty in New York virtually continued throughout the balance of the war, regardless of distance. Instead of taking place in a single room, it took place across an oceanic gap, bridged in a unique and effective way.

For a year following the summer of 1917, a stream of expert personnel, absolutely essential to Russel's organisation, defined by Russel, selected by Carty, supplied largely by the Bell Telephone System and allied telephone, telegraph and electrical organisations, flowed steadily across the Atlantic.

As Chief Engineer of the American Telephone and Telegraph Company, in thorough touch with all the engineering and technical talent available throughout the Bell Telephone System, and with the entire and whole-hearted backing of that nation-wide organisation; as President of the American Institute of Electrical Engineers; as Chairman of the Executive Committee of the National Research Council; and as an officer of the Signal Corps, in intimate contact with the per-

sonnel division of the Signal Corps,—Carty was able, as probably no other man in the country was then able, to lay his hand upon exactly the personnel Russel needed, with the utmost nicety of selection, and with the utmost care in assessing availability.

However, scarcely an expert thus selected by Carty and sent overseas, but carried a personal message from Carty to Russel.

He was invariably accompanied, first, by a letter of introduction telling who the man was, exactly what he had done and could do, exactly the niche he could fill.

In addition, usually, he carried a personal message, "inscribed in the tablets of his mind"—a message such as could not possibly be conveyed by any other medium.

By this continuous liasion, conducted with due regard to regulations, Russel was able to procure the constant advice of the foremost engineer of electrical communication in the world, without at the same time losing his precious services in mobilising expert personnel right at the home base.

It was a Perpetual Triangle, the characters in whose plot might be designated as Removers of Red Tape.

Russel would prepare his cable of requirements, to be incorporated into one of Pershing's regular cables and forwarded to Washington. The cable usually contained some such phrase as "Recommend this matter be referred to Colonel Carty for attention."

At the same time, Russel would write a personal letter to Carty, advising that the cable was on its way through channels, and explaining in detail the needs underlying the cable.

In due course, Russel's portion of Pershing's cable would be referred to the Signal Corps in Washington.

If it related to personnel requirements, it would promptly go to Colonel Curtis, one of the most able and conscientious officers in the Signal Corps.

Curtis and Carty worked hand in hand. By the time the demand thus reached Carty "through channels," he was ready with his carefully selected list, having anticipated the cable by virtue of direct advice from Russel.

All that remained, was to put through the proper official orders for overseas service, and—the men were on their way!

Thus were the waters of the Atlantic shrunk, and Washington and the A. E. F. brought more closely together during a crucial stage in the transition "from fingers to fist."

CHAPTER XVI

SCIENCE IN SHIRTSLEEVES: RESEARCH AND INSPECTION

Not so long ago, we were accustomed to think of a scientist as a long-bearded, absent-minded sort of gentleman, who occasionally dropped his spectacles into his soup and had to be reminded to take his clothes off before getting into the bath-tub.

The Great War has dissipated this spectre, as it has dissipated many another. The scientist has stepped out of the aura that enveloped him. The cloistered nook, to be sure, still remains: but it has a direct wire to the operator in the front line of events. Never before did the scientist even dream of playing so prominent a part in the stress and strain of daily life, as he played during—and has played since—the Great War.

If we look for an example of this curious bursting of the scientific chrysalis, we can find none better than that furnished by the Research and Inspection Division of the American Signal Corps in France.

The vital necessity for such an organisation became apparent to General Russel almost as soon as he arrived on the other side. Both the British and French had established, in connection with their Signal Corps equipment, an admirable system of research and inspection.

In Paris, the French Research Bureau was in charge of reserve officers, among whom were numbered some of their

most notable scientists and electrical and mechanical engineers. These trained specialists experimented with new devices, designed and redesigned apparatus, and, finally, when a device was put up in a practicable and serviceable form, made the approved model and drawings from which the manufacturers constructed the needed apparatus.

All this, however, was but one side of the job. Closely co-operating with the Research Bureau,—operating, in fact, under the same head, was an Inspection Bureau, which tested all devices before they were sent to the front, so that no waste material went forward, and the disastrous consequences of sending unreliable material to the fighting zone were largely obviated.

It was science militant. It was a system found indispensable during three years of bitter experience. In a war game which had become, largely, a brain-racking battle of technique, it was clear that the ultimate triumph lay with the largest and most effective technical equipment.

The function of the British and French Research and Inspection bureaus, therefore, at least insofar as the technique of signal equipment was concerned, was to keep several jumps ahead of the enemy, and at the same time to inspect, adapt, redesign and reconstruct, if necessary, all signal equipment destined for the front.

What would the American Army contribute in this connection?

The Allies were more than mildly interested. "The officials here," wrote Russel to Carty, "are very anxious to see some genuine American work and frankly confess their own inferiority in telephone matters."

But there was doubt as to what America could do with such a tremendous distance separating the home laboratory

and shop from the firing line. It was one thing to concoct a device in the quiet and secluded recess of a well-equipped home laboratory. It was quite another thing to drag the device forth to the firing line where, subjected to the ripping and tearing of shot and shell and hasty movement, its failure might spell the lives of thousands.

It was evident at the outset that the American Research and Inspection experts were to have a man-sized job on their hands. They would have to be equipped not only with extraordinary scientific training themselves, but also with unlimited resourcefulness and a strong sense of the practical.

It will be remembered that one of Russel's first official acts upon getting to work in Paris, was to forward his recommendations to General Pershing for the creation of a Research and Inspection Division of the Signal Corps in the A. E. F. The recommendations called for three majors,—one as head of the organisation, and the others as heads of the subordinate branches,—besides ten other officers and fifty non-commissioned officers and privates.

The recommendations further contained the request that the matter "be referred by the Chief Signal Officer of the Army to Major J. J. Carty, S. O. R. C., for recommendations as to personnel, equipment and supplies and that his recommendations be given due consideration and the matter expedited so that this personnel, properly equipped for the work in hand, may reach France at the earliest practicable moment."

At the same time Russel forwarded, direct to Carty, a copy of these official recommendations, explaining in greater detail the object he had in mind.

This was Act I of the play entitled "Removers of Red Tape."

Carty no sooner received this communication, than he began scouring the field for the most available timber. By the time the official recommendations came through from Washington, his list was ready and a tentative organisation chart prepared.

Russel had requested thirteen officers and fifty enlisted men. In all, before the Research and Inspection Division had rounded out its career, 50 officers and 210 men crossed the water to specialise on this work. They came so rapidly, so enthusiastically and with such exceptional personal fitness, that Russel was amazed.

"Frankly," he wrote Carty, "I am astonished and somewhat overwhelmed with the response you have made to my somewhat modest appeal for a Research and Inspection Division. I did not realise the perfection of the organisation you could appeal to, nor the extent of the talent which was within your reach. As a prominent representative of the great national scientific councils that are now doing so much in our great struggle, you have been able to do so much more for us in this Organisation than I at first thought, that I feel like the boy who asked for a slice of cake and got the bakery."

For the head of the Research and Inspection Division, Carty selected Herbert E. Shreeve, the engineer whom Carty had sent to Paris back in 1915, to listen atop the Eiffel Tower for wirelessed voices across the Atlantic.

It was also a bit of dramatic coincidence that the very officer who represented the French Government on that occasion was Colonel Ferrier, who was now in charge of the technical development of all military telegraph, telephone and radio apparatus, and with whom, consequently, Shreeve was shortly to re-establish relationships of the most intimate

sort—no longer as a distant neutral, but as an ally, fighting in the same cause.

But Shreeve had more than this coincidence to recommend him. For 22 years he had been engaged in the development of telephone, telegraph and radio equipment, first as an engineer with the American Telephone and Telegraph Company, then as executive officer of the Research Department of the Western Electric Company. During the formal opening of the New York-San Francisco transcontinental telephone line, Carty had sent Shreeve to San Francisco to handle that end of the operations. It was absolutely essential that no break should occur at that time, and Shreeve managed his end perfectly. On his Paris assignment, Shreeve had a most difficult mission to accomplish, both technically and diplomatically. He managed the affair with entire satisfaction, co-operated effectively with the American Naval Attaché, and made a complete success of the job.

To assist Shreeve as head of the Research Section, Carty selected a brilliant physicist named Oliver E. Buckley, a young man of exceptional initiative, resourcefulness and judgment, naturally of a scientific mind, and trained to the minute in the latest developments of the new telephone science that had been built up around vacuum tubes and allied apparatus. Buckley, as a member of the Western Electric organisation, had been commissioned Lieutenant in the Signal Reserve, and had rendered notable services in submarine detection.

As head of the Inspection Section, Carty nominated a man whose appointment for this work created no small amount of temporary consternation in the ranks of the New York Branch of the Western Electric Radio Company, designated as Company A, 319th Field Signal Battalion. For it was the

company commander of this outfit, Captain—later Major—Maurice K. McGrath, who was selected for the job.

McGrath had spent five years in Antwerp, as assistant chief engineer of the Bell Telephone Manufacturing Company, and six years in Italy as assistant manager and chief engineer of the Western Electric branch establishments in Rome and Milan, charged with the design and manufacture of military telephones, telegraphs, heliographs, luminous gun sights, revolution counters and the like for army and navy purposes. He spoke French and Italian fluently, he knew manufacturing conditions back home,—in short, he was just the man to head the Inspection branch of the Research and Inspection Division. It was on that account that he was detached from his radio outfit, along with about thirty men from his company as well, leaving a heartbreaking task of re-organisation for his successor as company commander,—a task whose successful accomplishment will be detailed elsewhere.

Besides Shreeve, Buckley and McGrath, the other officers and enlisted men needed to supply the brain and sinew of the new organisation were selected with equal care and discrimination. They were a "handpicked lot of experts" if ever there was one. More than half of the enlisted men originally sent over were university graduates.

In selecting these experts, Carty was by no means confined to Bell organisations. He had access, in point of fact, to what virtually amounted to the entire national reservoir of scientific personnel in the country.

It was in April, 1916, shortly after the attack on the *Sussex,* in the critical situation developed by our demands for the cessation of submarine warfare, that the National Academy of Sciences, at the request of the President of the

United States, had so organised the scientific resources of the country, had so closely brought together the various scientific research agencies, governmental, educational and industrial, that the resulting organisation, the National Research Council, could without question be said to represent the highest stage of national scientific co-ordination ever attained in this country.

Upon invitation of the Council of National Defence, the National Research Council had drawn in with that splendidly perfected agency, completing the process of co-ordination with the rest of the nation's resources.

Now, how to give Russel the fullest possible benefit of this superb array of talent was the problem Carty set himself to solve.

The proposed Research and Inspection Division for the A. E. F. Signal Corps furnished a very real beginning in this direction, but it was by no means the final and complete solution.

"My idea has been," Carty wrote Russel, "that a great deal of important work must be done by scientists right on the ground under your command in France, but this would not be a substitute for the immense research establishments we will have working for you here. The idea is rather, as I take it, that you are establishing in France an advance scientific base which will render invaluable service to the Army in numberless ways and that it is important that this advance scientific base be properly proportioned and properly related to our scientific activities in this country."

And, writing further of the scope of the National Research Council, Carty went on to say: "I am Chairman of the Executive Committee and recently we appointed Dr. R. A. Millikan of the Chicago University as Director of Re-

search. He is giving his entire time to this work and is practically our executive officer in Washington."

Dr. Millikan, in fact, was acting in a dual capacity, and was doubly effective in thus multiplying his points of contact. General Squier, Chief Signal Officer of the Army, had helped the work along by securing the appointment of Dr. Millikan as Major in the Signal Corps, and thus Major (later Lieutenant-Colonel) Millikan became head of the Science and Research Division of the Signal Corps, as well as executive officer at Washington for the National Research Council.

"Thus through Major Millikan as Director of Research," Carty continued, "and myself as Chairman of the Executive Committee, the Signal Corps has direct and intimate relation with the entire scientific mind of this country, and I might add, with the rest of the world, for similar organisations are springing up in other countries and are entering into relations with our Council."

It will therefore be seen that the National Research Council was not only of great help in securing scientists for the Research and Inspection Division of the A. E. F. Signal Corps, but, as Carty reminded Russel, "We have, through this organisation, an excellent method of obtaining for you the ablest scientific assistance in the world, provided"—and this was the nub of the thing—"*provided we know just what may be needed.*"

In other words, what was most needed was a bridge of complete understanding across the Atlantic. We had an advance scientific base about to be established in France, we had the scientists back home,—"to a man," Carty wrote, "these scientists are anxious to help you. They only want to know the best way." But—

What *was* the best way? It was obvious that mere letters and cablegrams could not adequately supply the answer.

The bridge was furnished in the person of Edwin H. Colpitts, Research Engineer of the Western Electric laboratories, and a scientist of the most up-to-date kind; in fact, one of the best all-around scientists in the world, insofar as the art of electrical communication was concerned.

Colpitts knew not only science, but scientists, was thoroughly conversant with the factory situation at home, was acquainted with the organisation and resources of the National Research Council, and especially of the American Telephone and Telegraph Company Engineering Department, with which he was closely associated; and was, besides, Dr. Jewett's right-hand man at the Western Electric laboratories from which a large part of Russel's signal devices were to issue.

"We are absolutely depending upon him here in this country," Carty wrote to Russel. "I am depending upon him to lay before you the whole situation in America and to get from you the best possible view of the situation in France, so that upon his return to America we will have a perfectly complete understanding with you."

It was the original intention to commission Colpitts a Major in the Signal Corps, but his Canadian birth, and the fact that he had not yet taken out his final citizenship papers, prevented this. It was necessary, however, that he be given an official status during his visit abroad. He was, therefore, appointed a civilian employee of the Signal Corps at a salary of a certain number of cents per week, with the high sounding title of Inspector of Something or Other. Thus equipped, he sailed for France on September 8, 1917. With him sailed Shreeve, Buckley and McGrath, who were to organise the

Research and Inspection Division, and a Western Electric engineer named Howk, of whom more will be told later on.

Shreeve and his select group of experts had been bidden to prepare for their new duties. Exactly what these were, they had only the vaguest notion,—in fact, no notion at all. All Shreeve knew was that he was to be the head of a Research and Inspection Division and that this would involve a considerable amount of laboratory work.

Shreeve, therefore, proceeded to make arrangements for the equipping of a complete laboratory, including at least the fundamental mechanical and engineering necessities. These were carefully packed into several hundred packing cases labeled with painstaking exactness so that they could be immediately identified and installed upon their arrival in France, and then the whole lot was put in charge of an officer, who was instructed to "marry that stuff and stay with it until it got safely over on the other side."

Not a thing was wasted. Even the boxes in which the material was packed were specially designed so that they could be used for the construction of laboratory benches and tables.

Some time thereafter, had you followed Shreeve and his cohort of experts, you would have found them on their hands and knees engaged in the vigorous if inexpert task of making inroads with scrubbing brushes and mops upon the most appalling accumulation of dirt that had ever formed a permanent crust over any building in France.

The building in question was shortly to serve as the laboratory of the Research and Inspection Division. It had formerly served as the abode of the Ecole de la Marine. It stands near the Gare Mont Parnasse, in Paris,—a stuffy structure of old stone, built in the style of eighteenth century France, still maintaining, in its appearance, elements of pre-

revolutionary grandeur, to say nothing of a total lack of ventilation, and a rich acquisition of dirt, both inside and out,—the dust of the centuries.

French labour to effect an immediate housecleaning was out of the question—*ce va sans dire*. But Shreeve and his outfit did not intend to let a little thing like dirt stand in the way of an immediate assault upon their new duties; and hence their menial preliminaries.

Before very long they got down to work in real earnest.

One would suppose it would take months for such an organisation to justify itself. During the first week or two, as a matter of fact, this group of scientist-soldiers was either completely ignored, or else viewed with scepticism, if not suspicion, by the conservative wing of the "regulars."

And then they began to be heard from!

Scarcely a month after the Research and Inspection Division begun to function, Russel wrote: "Already the character of this personnel is making itself felt, and there are many enquiries from other Branches of the Service as to the possibility of utilising the Research work for their own Departments."

Emerson once observed that excellence in product, be it only a mouse-trap, will force a beaten path to your door.

Gradually, the Division's reputation for ingenuity and resourcefulness grew. It grew not only throughout the A. E. F., but spread to Allied circles of military technique.

And here Shreeve's prior relations with Colonel Ferrier, now in charge of the technical development of all French military telegraph, telephone and radio apparatus, proved of immense value.

Shreeve and his associates, fortunately in no sense theorists, saw that to be most effective, they would have to study

and understand thoroughly what had already been developed by the Allies, before they could even begin to rely upon American production. They had to study French methods first, and know exactly what was needed: how existing Allied apparatus and equipment were being used, what their advantages were, what their defects were, how the American army could put them to use in the shortest space of time, how and how soon they could be improved upon,—in short, what the immediate, bread-and-butter technical necessities were, and how they could be most effectively obtained and applied.

Pretty soon it became known that the Research and Inspection Division of the Signal Corps was actually producing designs that were new, material improvements that were of unquestioned military importance.

Much to the surprise of the Doubting Thomases, "high-brow" methods were being actually and practically applied to war uses.

In a few months, the Research and Inspection Division of the Signal Corps was being swamped with requests not only from other divisions of the American army, but from Allied sources as well.

It must be remembered that for a long time the Research and Inspection Division of the Signal Corps was the only technical unit in the A. E. F. In addition to this, Shreeve shortly became a member of the Interallied Technical Board of Inventions, and in this capacity was constantly called upon to inspect devices of one kind or another not confined to Signal Corps work nor limited exclusively to the American Army. In this capacity a large number of inventions were referred to Shreeve, at least one-half of which were deemed of sufficient importance to be referred to the proper authorities with the report of the Interallied Board attached.

It is impossible to overemphasise the importance of this type of service rendered by the A. E. F. Signal Corps Research and Inspection Division. Some such central agency was absolutely essential to catch and co-ordinate the host of suggestions thrown off "into the air" by direct and immediate contact at the front. But for this means of catching on the wing these loosely floating but immensely vital ideas, and tying them up to some central authority, where they could be investigated, given body, if practical, and made available to all engaged in the same cause, an asset of incalculable value would have gone a-glimmering.

The result of all this, of course, was to impose a ceaseless grind upon the Research and Inspection Division, which obliterated all distinctions between day and night, week-days, Sundays and holidays. The Division was doing its work so well that it simply could not keep away the incessant stream of demands upon its time, its energies and its ingenuity.

And yet no request was met with a refusal, whatever the source and whatever the nature of the request. Indeed, the endless variety of requests that came in were such as would baffle the most diligent keeper of a scientific museum—requests for inspection, suggestions for improved designs, etc., dealing with telephone and telegraph devices of a hundred sorts, with radio, including airplane radio, Swiss watches, poles, parachutes, rockets, Very lights and the like,—their index alone would fill a volume.

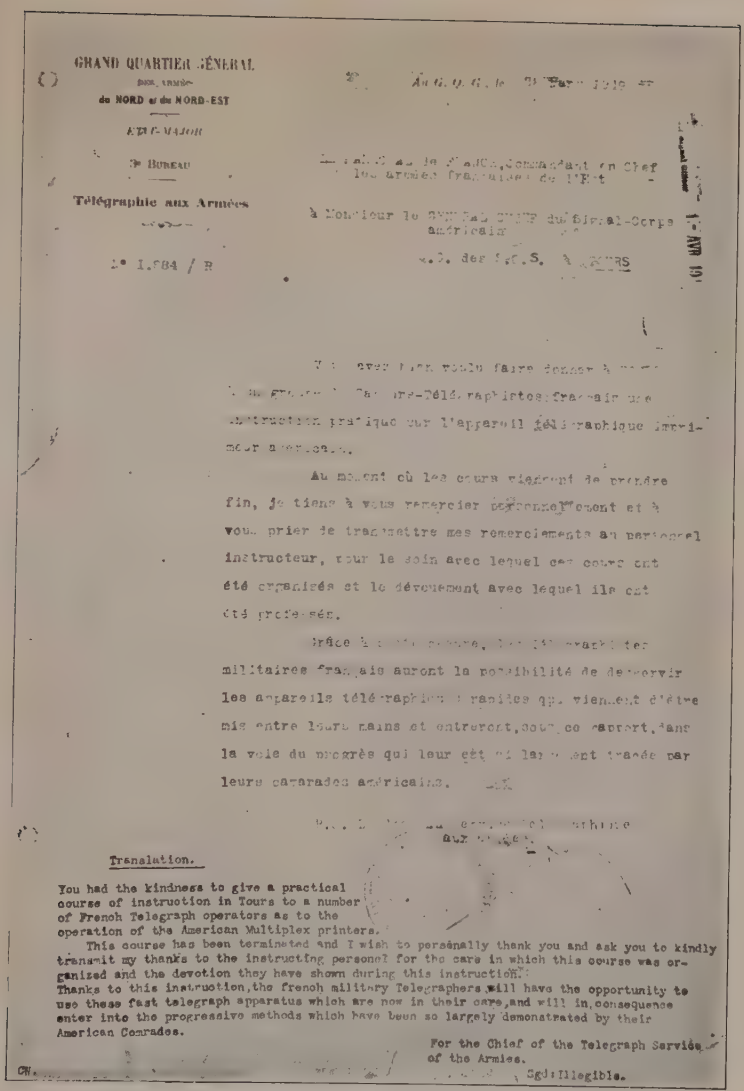
One day Shreeve was notified that he would have to make an inspection of ninety tons of *chenille*. Shreeve had no more conception of what *chenille* was than of the true ingredients of the moon. This, however, did not in any way prevent the inspection from being made. Shreeve simply had one of his men go to a French plant and find out what it was. He dis-

covered it to be a certain type of signalling flare. He then studied its production from A to Izzard, returned qualified as an expert, and made as thorough an inspection as could possibly be made by the most seasoned veteran.

Another day a call for help came from the Ordnance Department. They were having difficulty with the illumination of cross-lines on artillery pieces. The problem was how to furnish sufficient light without attracting the enemy's attention. Shreeve went to the front himself, equipped with a pair of scissors and a tomato can, and worked the thing out in a dugout. In a week he had designed a lighting system which in every way met the requirements, and placed it on a basis where it was ready to be produced in large quantities under heavy orders. Later, when the First Division went into line at Montdidier, the commander of one of the brigades sent his aide to Shreeve with the request, "Give us all the devices you can in a hurry—within two or three days, if possible." Shreeve loaded a whole carful of them into a Cadillac, and the very next day they were rolled away into action.

Shreeve, incidentally, was always exceedingly modest about these remarkable achievements. "Nothing but a Western Electric job," he once remarked to an assistant, "applied to new conditions. Design—laboratory test—specifications—factory—*rush:* wouldn't you think you were back home with the Western Electric?"

And, indeed, it is precisely because the Research and Inspection Division adopted the *modus operandi* of its commercial prototype back home, that it yielded such remarkable results. In fact, the officers of the Research and Inspection Division would be the last to claim exclusive credit for the designs and improvements which they effected; in the matter, for example, of the design of the mobile telegraph and tele-



GRAND QUARTIER GÉNÉRAL
de NORD et de NORD-EST
ETAT-MAJOR
3e Bureau
Télégraphie aux Armées
N° 1.584 / R

Au G. Q. G. le 31 Mars 1919

à Monsieur le Général Chef du Signal-Corps américain

Translation.

You had the kindness to give a practical course of instruction in Tours to a number of French Telegraph operators as to the operation of the American Multiplex printers.

This course has been terminated and I wish to personally thank you and ask you to kindly transmit my thanks to the instructing personel for the care in which this course was organized and the devotion they have shown during this instruction.

Thanks to this instruction, the french military Telegraphers will have the opportunity to use these fast telegraph apparatus which are now in their care, and will in consequence enter into the progressive methods which have been so largely demonstrated by their American Comrades.

For the Chief of the Telegraph Service of the Armies.

Sgd: Illegible.

ACKNOWLEDGMENT FROM MARSHAL FOCH

Through his personal representative, Lieutenant-Colonel Fatou, Chief of the Service Telegraphique of the French armies, to the Chief Signal Officer of the A. E. F., in the matter of telegraphic communication.



U. S. Official

WAR ON EARTH, GOOD WILL TO MEN

Illuminated cross displayed over American Army Headquarters at Bordeaux, France, on Christmas Eve, by order of General Headquarters.

phone offices, and in the large number of radio, telegraph and telephone devices which they brought into rapid production for emergency needs. As will be seen hereafter, these were in large part the result of co-ordinated effort, including the indispensable co-operation of the Western Electric and other commercial organisations back home, of the Science and Research Division of the Signal Corps, and other scientific bodies, as well as a large number of brilliant telephone and telegraph engineers at work in France.

The unique position of the Research and Inspection Division is well set forth in Russel's own precise military language: "At the same time (i.e., while the Division was setting up its laboratories in Paris) similar laboratories were being opened in this country (U. S. A.), which initiated many valuable devices, and these were passed on to our Paris laboratory. This in turn submitted its own modifications to Field Signal battalions for immediate test under service conditions. The output from this triple team work is believed to have given results quite unique in speed and efficiency. By keeping together this body of fine scientific workers where they could continue researches under favourable conditions, and at the same time have military direction and environment, with the constant inspiration of immediate contact with men from the front, we were enabled to utilise our scientific forces in the most effective way."

CHAPTER XVII

THE NET TAKES SHAPE

In the brief but active career of the A. E. F. Signal Corps, we find, mirrored in miniature, the various stages of development that marked the growth of the telephone art and system.

Take, for example, the first few days of A. E. F. history. We start with one or two essential telephone installations in Paris—installations of French instruments. These, based on the American standard, are exceedingly crude and primitive, being largely "magneto," and representing a stage abandoned in the United States two or three decades before in favour of the more up-to-date "common battery."

We suddenly jump, in the space not of a few decades, but a few months, from "magneto" to "common battery," from the French boards of June, 1917, at American headquarters in Paris, to the American boards installed in the new American headquarters at Chaumont in August, 1917.

And then comes the interurban or long distance stage of development—the laying of the basic net; starting with that portion of the "400-mile line" running from Dijon to Neufchâteau, begun by the 406th and 407th Telegraph Battalions early in September, 1917, and completed by the end of the month; expanding to other parts of France at the same time by such lines as could be spared from the French system.

But so far, all is purely catch-as-catch-can—exactly as was

the entire beginning of America's effort in France; and naturally, for it was the policy dictated by common sense: "Don't look too long before you leap, for there isn't time; but look enough to make sure you land on your feet. *Then* —when you have got under way—lay your fundamental plans; not pausing for the purpose, but as you go along, so that no time shall be lost in the process of planning."

So up to the Fall of 1917 in France, we were still in the early stages of getting under way. With an up-to-date American telephone establishment for the new American headquarters at Chaumont, with connections over French lines to Paris, with American telegraph offices at Paris and Nevers, with an American-built, American-operated telephone line from Dijon through Chaumont and Neufchâteau to Gondrecourt, headquarters of the First Division, and with switching points at Chaumont, Dijon and Neufchâteau,—the immediate bread-and-butter necessities of electrical communication were provided for.

And now the "building large" programme, as originally designed, could proceed. That programme, as we have seen, was nothing short of transplanting to French soil a complete replica of the American system of electrical communication, with all its refinements and last-minute devices.

Things were beginning to take shape. Back in May, 1917, the data supplied from the A. E. F. on the basis of which plans and specifications had to be drawn, had been so vague as to amount almost to guess-work. With these plans as a guide, the "400-mile line" had been projected, to provide certain fixed facilities between two points—the base port and the probable headquarters back of the American sector at the front; together with a "265-mile line," which was to branch off at right angles from the main line.

Moreover, while this main line was in actual process of construction by Bell Battalions right on the ground, General Russel had others at home working on the advance features of the same task. Colonel Carty, stationed at the headquarters of the American Telephone and Telegraph Company, together with Lieutenant-Colonel Jewett, stationed at the Engineering laboratories of the Western Electric Company, and engineers of both these organisations associated with these officers, were working away at the engineering features involved in the fundamental plan of A. E. F. wire communication, the expert personnel that would shortly be required to maintain and operate it, the devices with which it would be necessary to equip it in order to bring it to its highest point of usefulness.

The growth of the A. E. F. net had been natural and opportune. First Repp and Glaspey, of The Bell Telephone Company of Pennsylvania, had gone over with Russel on the original Pershing expedition as "surveying pioneers," so to speak; then the First and Second (406th and 407th) Battalions had gone over, as building pioneers; and then Colpitts had gone over, as a bridge between the main scientific body back home and the scientific vanguard to be established overseas by Shreeve, Buckley and McGrath, through the medium of the Research and Inspection Division.

The progress made by Russel up to this point was truly remarkable; but the system was still a long way from its goal. To place the telephone and telegraph system of the A. E. F. on a basis of operation approximating the American standard, the 400-mile line would require two telephone "repeater" stations, at each of which there must be provided also telegraph "repeaters" suitable for both Morse and printing telegraph operation.

For the "printer" telegraph was part of the entire scheme. Its capacity to eat up an enormous amount of traffic—at the rate of six messages simultaneously over a single wire—was such as was bound to prove of incalculable value in speeding up the A. E. F. But it must be installed *in time,* to anticipate the rapidly rising traffic and stand ready to handle all that came its way.

Then there was the matter of joint use of lines for telephone and telegraph operation: every last ounce of traffic must be squeezed out of existing facilities by the highest possible economy and efficiency in operation. The problem was by no means as simple as it sounds. Telephone "repeater" and telegraph "printer" experts were scarce. The science was new. The proper expansion of the A. E. F. electrical communication net would require a considerable force of trained "repeater" and "printer" specialists to supervise and operate the equipment, as well as a large number of specially trained mechanicians and equipment men, testboard and central office men, to install and maintain this highly specialised electrical equipment at terminal and intermediate stations.

Carty knew exactly who and where these men were that could "put the job across," but it was by no means an easy matter to get at them. He began by selecting Lieutenant—later Major—Frank H. Fay, a highly trained specialist, as well as an all-around student of electrical science, who was a leading expert on telephone and telegraph circuit requirements, and had perhaps as thorough a grasp as any engineer in the telephone game, of duplex and printing telegraphy, including composited, phantomed and simplex lines.

But how to provide Fay with the necessary staff and working force for so highly specialised a job was the perplexing problem. Mere raw recruits innocent of the science of elec-

trical communication, simply would not do. Without the foundation on which to build, they could not possibly be trained in the necessary time. They would have to be, in fact, trained technicians before they could begin to be trained in these super-specialised, last-minute developments in telephony and telegraphy.

There was a considerable number of such men with the twelve Bell Telegraph Battalions already organised, and the two Western Electric Radio Companies; but these, especially the two battalions already in France, had been so heavily drawn upon, that it was not felt safe to go much further in that direction.

In the search for these men, the records of the Bell Telephone System and the Western Union were gone through with a fine tooth comb. They disclosed that F. J. Clarke, one of the few telephone "repeater" experts in the country, was at this time serving as Signal Supply Officer down in Camp Meade, Maryland. Carty immediately requisitioned his services, in a letter to Washington requesting that overseas orders be issued for Lieutenant—later Captain—Clarke to accompany Fay.

But in the case of the soldiers, the solution was not so simple. An attempt was made to draw the needed personnel from former employés of the Bell Telephone System who had already entered the military service in branches other than the Signal Corps. The names and organisations of the men desired were obtained, and a request was made through the Adjutant General for the transfer of these men to the Signal Corps with a view to their immediate dispatch to the A. E. F.

And here it was that the military policy was first encountered, which later gave so much trouble in obtaining

properly trained personnel for the highly specialised branches of signal duty.

The policy in question was that of refusing to transfer a man by name from line organisation to the Signal Corp, without the consent of his immediate commanding officer.

Say you want Bill Smith, a highly trained testboard man. Smith is now serving as company clerk in X Company, Nth Infantry. He loathes the duties of company clerk. There are at least ten other men in his company better qualified for the post, and far less averse to it. You need Smith immediately for service overseas, because of his specialised knowledge. You apply, "through channels," to the Adjutant General for his transfer. In due course, your request for the transfer gets down to Smith's commanding officer, Captain Jones. Jones is the average officer, with the average military burden heaped upon his shoulders, and the average inclination toward the path of least resistance. In ninety-nine cases out of a hundred, Jones returns the request for Smith's transfer with the formula, "This man cannot possibly be spared from his organisation."

That settles it with the Adjutant General. Smith remains where he is.

Notwithstanding difficulties of this nature, Fay and Clarke left for overseas early in October, 1917, with a contingent of nineteen men, to be followed shortly thereafter by seven others, making a total of twenty-six specialists who were to furnish the A. E. F. with what in the United States corresponded to the Long Lines Department of the American Telephone and Telegraph Company, the Western Union Telegraph Company and Postal Telegraph Company,—all rolled into one. They were to provide an operating and maintenance personnel for the A. E. F. Long Lines System that

would enable it to run in such a way that our Army would find no difference between the system of electrical communication placed at their disposal in France, and that to which they were accustomed, as business men, back home.

This meant a maximum of efficiency known to the science of electrical communication, including the telephone "repeater," the telegraph "printer" and the fullest possible utilisation of "composites" to effect a joint telephone-telegraph use of the lines.

As a matter of fact, the programme actually adopted by these specialists proved far more ambitious, and the job they actually did far more extended in scale, than was dreamed of at the start. For by the time they were at work, a new design had been mapped out for a network of wires to be thrown across the length and breadth of France, as superior to the old 400-mile scheme in scientific layout as the network of New York is to that of Mexico, and as far ahead of the old plan in comprehensiveness and completeness of development as the network of the United States is to that of any one of its commonwealths.

And this introduces to us Lieutenant C. L. Howk, a Western Electric engineer with a marvellous grasp of the infinite detail involved in the fundamental planning of electrical communication systems.

Howk was one of the officers who accompanied Colpitts on his special mission to France. He was to serve in the nature of a general assistant and understudy to Colpitts during his stay abroad; to tuck away, in the folds of his technical mind, every item of information that could possibly help his brother engineers back home to gain an accurate understanding of Russel's needs in France. Then, the survey completed, he was to return with all this precious

first-hand information, viewed through the eyes and reported on in the terms of a first-class, telephone-telegraph engineer.

Howk had no sooner arrived in France, however, than he was seized upon as *the man* to reorganise and redesign the fundamental plan of the A. E. F. net. He was planted at a desk in Chaumont and requested to get busy.

Howk got busy. For weeks on end,—with time out for meals and sleep, but for nothing else,—he ground away at the details of what he conceived to be a properly adapted, scientifically arranged network for the lines of communication in France. And then he submitted his recommendations.

As a result, the old 400-mile line idea with its 265-mile extension was abandoned in favour of a network hooked on to six basic points of communication, to be known officially, and referred to in cables and correspondence, as points A, B, C, D, E and F. Actually (but then known only confidentially, of course), these points were St. Nazaire, Tours, Autun, Chaumont, Bordeaux and Paris respectively. The plan also provided for the absolute maximum of line utilisation possible under the circumstances, including simplexing, compositing, phantoming and the use of multiplex printer telegraphy.

It was this fundamental plan designed by Howk that furnished the basic design for that remarkable system of electrical communication in the A. E. F. which, naturally taken for granted by our own Army, evoked such unstinted admiration on the part of the Allied staff.

Howk returned to the States early in 1918, with his head literally crammed full of the thousand and one details on which there was urgent need for education back home. The information thus conveyed proved of the utmost value to the Signal Corps in Washington, and to the Western Electric

engineers at work on Russel's signal apparatus, equipment and supplies.

Colpitts had preceded Howk by several months on his homeward return. His scientific grasp and mature judgment had proved of inestimable value to a man like Russel, eager and able to take full advantage of the highest scientific talent that offered. With Shreeve and Buckley, Colpitts had attended frequent conferences at headquarters near the front, had visited the front lines to get his perspective properly placed, and had had a large hand in laying the practical scientific foundations for the work of the Research and Inspection Division. In addition, he had lent his ripe experience to numerous scientific ventures of far-reaching military importance outside the scope of the Signal Corps proper. For example, at the request of the Secretary of the Navy, he and Shreeve had gone down to Toulon, France, to get the latest information on submarine detection methods, and this information, upon his return to the States, was matched up to excellent advantage with the results of American research.

"I believe," Russel wrote to Carty, after Colpitts had sailed on his homeward voyage, "Colpitts got a singularly clear and coherent view of things, and as he is a man of wisdom and experience, I am sure you know much more about our situation than could be conveyed by any mere letters."

The results that followed amply bore Russel out in this.

CHAPTER XVIII

A MILITARY MARRIAGE: A. E. F. TELEPHONE AND TELEGRAPH

BACK in the Fall of 1909, a marriage of business enterprises took place, which promised in every way to be industrially eugenic. The American Telephone and Telegraph Company acquired a substantial degree of control over the Western Union Telegraph Company, and announced at the same time that joint economies were planned, which could not but prove of ultimate benefit to the public as well as to the organisations affected.

The first offspring of this union came in the form of the Night Letter, which has since become so indispensable to our system of intercommunication.

A considerable programme of additional economies and augmented efficiency was being mapped out when, during the first administration of President Wilson, a great hue and cry was raised against all forms of organisations which, irrespective of their object or nature, were considered as combinations "in *restraint* of trade."

The result was a voluntary dissolution of the union between the American Telephone and Telegraph Company and the Western Union Telegraph Company, brought about because it was not believed that the best results would follow, except with the heartiest approval and co-operation of the public.

Thus was a promising programme of enlarged service to the

public, expected to result from joint telephone and telegraph operation, killed "a-borning."

Exactly eight years later, a similar marriage took place in France. This time no decree of divorce was issued until the union had effected its purpose, and, incidentally, demonstrated to the world what Vail meant when he promised that the union of 1909 would prove of benefit to the public.

"Of benefit to the public" scarcely describes this latter union. It was of vital consequence to the cause of civilisation. Indeed it is questionable whether, had not the A. E. F. Signal Corps adopted joint telephone and telegraph operation in France, it could ever have met the requirements of our overseas army.

For there we were, operating 3000 miles from the home base, with signal supplies—even the most fundamental—sometimes apparently as far away as if they had been in the moon; with conditions such that every possible corner had to be cut, every conceivable economy in construction and maintenance effected, every scientific device for maximum utilisation of lines taken advantage of.

It was on this account that not a single long distance wire was strung in France for purely telegraph purposes,—all the telegraph lines obtained having been "superimposed" on the telephone system, with the exception of one or two strung along railroads where only telegraph lines were required.

In other words, except as noted (and except at the front, of course), there was no such thing as an exclusively telegraph wire strung in the entire A. E. F. From start to finish, the Signal Corps telephone and telegraph engineers had before them not merely a telephone job, plus a telegraph job, but a *joint telephone-telegraph job,* which presents prob-

lems not to be found in the separate operation of either or both services.

Now there is one very remarkable thing about this telephone-telegraph system established by the A. E. F. Signal Corps, and that is, that never throughout the entire period of the war was a single headquarters isolated from the rest of the A. E. F. because of a breakdown in the system, whether due to sleet, storm, or any of those other causes which, on occasion, have completely paralysed telephone and telegraph systems during peace times; to say nothing of the military factors that might have proved just as destructive as any of the mischievous tricks of Nature.

It is a circumstance that furnishes food for thought. Consider how fatal might have been the consequences had there been any such breakdown in France; how essential it was to the proper working of our great war machine, that the Commander-in-Chief of the American Army should have been able to pick up his telephone receiver wherever he happened to be, and communicate with any and every sector or division of his forces *at any time;* how important it was to the success of our efforts that the Chiefs of Services of Supplies should be in constant telephonic or telegraphic communication with the officers in charge of unloading troops and supplies at the base ports scattered over the coast line of France, from Le Havre on the north, to Brest and St. Nazaire on the west, to Marseilles on the south; how indispensable it was to the integrity of the system as a whole that there should be a complete and uninterrupted pathway of communication from the chief of staff of every branch of the American army, clear down along the line to the front.

Naturally enough, the absence of any disastrous breakdown in this magnificent system at any time, is simply taken

for granted. We rarely appreciate the dangers we have missed. But the fact that such an unfortunate condition never occurred during the emergency is in itself a tribute of the highest sort to the vision and leadership of General Russel, Chief Signal Officer of the A. E. F., as well as to the superb quality of engineering and the excellence in construction effected under most trying conditions by the engineers and plant men under him.

Not only was this telephone-telegraph system maintained intact throughout the period of the emergency, but it was practically *the only military wire system which covered the whole of France,* to say nothing of extending later far into Germany.

The English telephone and telegraph network was confined to the area occupied by their army in northern France. The French telephone and telegraph network, so far as it was military, was not countrywide, either. Its nationwide telephone and telegraph network was a peace-time one, which had existed for decades and was now, during the emergency, being operated by civilians, most of whom were old men and women who had been connected and long been familiar with the system, and were therefore familiar with every detail involved in its operation.

The A. E. F. system was operated by men unfamiliar with the geography and language of the country, and to all intents and purposes fresh to the job. But their splendid training back home with a wire system that had no parallel the world over, plus a remarkable degree of personal adaptability, now came to their rescue, and the job was accomplished in a way that far surpassed the rosiest expectations back in Washington at the outset of the war.

All this is merely a statement of *what* was done. *How* it was done is another story.

In the latter part of October, 1917, Fay, Clarke and the contingent of telephone and telegraph repeater specialists arrived in France.

Fay was given complete charge of the upbuilding of the A. E. F. telegraph system, Clarke was assigned to the telephone end of the game, and the business of developing and operating the Signal Corps lines of communication in France, on the most modern and approved basis, was begun in earnest.

So far, naturally, the telegraph development had been purely opportunistic. Only those telegraph offices were established which immediate necessity demanded.

On August 9, 1917, the first Signal Corps telegraph office had been opened at the Hotel Mediterranee in Paris, connecting over a French line with another Signal office opened at Nevers, the new supply base, and operating by means of French instruments. On August 30, 1917, another telegraph office had been opened at Chaumont, a day before General Pershing established his new headquarters there, and this telegraph office was connected to the American office in Paris over a French line. By the end of October, 1917, two telegraph offices had been established in Paris, and in addition to these, and the offices at Nevers and Chaumont, additional telegraph offices had been established at Gondrecourt, Le Havre and Tours, all the circuits being obtained from the French, and all being operated "open circuit," with French instruments.

It was at this stage that Fay and his experts arrived.

And their problem was precisely the problem with which their brother engineers in the telephone end of the game had been grappling from the very start: "Build, build fast, and

build with such bricks as you can manage to scrape up—such as the French may have left lying around loose, after three years of remorseless 'search and seizure'; or make the bricks yourselves, with straw that you will have to find."

Not that the French were unwilling to share what they could spare. On the contrary, they were more than generous in those early days of sore trial. But what *was* not, simply *was* not. And an adequate supply of telegraph equipment, there was not.

Said Fay, speaking of the job that confronted him:

> It was a case of doing what you can with what you've got. We had to find a way to give service at all costs. It was like starting to do business with a little shack, made up mostly of borrowed material and foreign furnishings, and building up, from that, to a complete, up-to-date fireproof building; and all the time with the sign hung out, *"Business going on as usual during alterations."* Only, we had to bear in mind that what we did would have to be co-ordinated with the rest of the A. E. F. system, so that it would at all times fit in perfectly with the entire scheme.

Telegraph traffic had begun to mount alarmingly. This was the fall of 1917, and the A. E. F. was growing by leaps and bounds. "Deliver, you highbrows, or step out!" seemed to be the sword of Damocles, suspended over Fay's head.

Fay began to deliver. His first step was to change from "open" to "closed" circuit, permitting the use of American sending machines (Vibroplexes), and speeding up the service all along the line, by adapting it to American telegraph practice.

Then Fay proceeded to *double* the available capacity of existing telegraph lines, by simply "duplexing" the circuit, i. e., so equipping the line that it would permit two messages to pass over it simultaneously, one in each direction. "It was largely a shopping job," said Fay.

Of course there was no American duplexing equipment to be had: no signal supplies of any kind had yet arrived from the States. So we had to hunt for it in the Paris supply houses. The French did little in the way of duplexing; you can therefore imagine the job we had trying the locate the equipment. We finally scraped up sufficient apparatus to make up four simple duplex sets. We sent two of these to Chaumont, installed them on the operating tables, and on November 23, 1917, we had a duplex circuit in full operation along the heavy and rapidly swelling artery of traffic between Paris and Chaumont.

Subsequently, we located apparatus for making up ten additional duplex sets, and these we installed at Paris, Tours and Nevers.

And the surprising thing about it is, that in spite of the haphazard way we picked up this apparatus—of course we had to make up the telegraph sets ourselves from the electrical equipment purchased—really excellent duplexes were obtained, and pretty good service resulted.

In the meantime, Fay had put in his order for standard, American-made telegraph apparatus. It was all very well to improvise telegraph service from rare and random specimens of apparatus picked up in the course of desperate shopping, but if the system was to build up on a scale commensurate with the requirements of the American army, complete American equipment must be forthcoming.

"Well, what of it?" would seem to be the natural query. "That ought to be simple enough."

Perhaps it ought to be, but it wasn't. As a matter of fact, the signal supplies, at the time, simply were not coming through.

Fay knew that not one item on the extensive list of signal equipment requisitioned way back in May, 1917, had as yet reached France. He knew, also, the consequent difficulties that had been met with in the course of pioneer telephone

construction by the 406th and 407th Telegraph Battalions. And he schemed for a way "to beat the game."

Quite by chance, he learned that the Paris branch of the Western Electric had a certain amount of cargo space reserved on the French Line steamships, which they were not using. Why could not an order be placed in this manner direct?

It was worth trying, and Fay tried it. He placed an order for 100 telegraph sets, and a certain amount of miscellaneous telephone material.

It worked!

The material arrived on January 25, 1918, a good ways ahead of any of the equipment ordered eight months back through regular channels; and it furnished the first complete American telegraph sets installed in France.

CHAPTER XIX

WAR ON EARTH, GOOD WILL TO MEN

While flaring starshells, bursting fitfully over No Man's Land, continued to tear malevolent gashes in the darkness of December's closing nights, a new star was preparing, if only for a night, to rise and outshine the rest—the Star of Bethlehem.

Christmas of 1917 was to find four Bell Battalions in France.

Besides the 406th from Pennsylvania and the 407th from New York, two additional battalions had arrived: the 408th from the Northwestern Group, and the 409th from Chicago.

The latter was celebrating under difficulties.

Behold Captain Borden with a detachment of men, the scent of Christmas turkey in their nostrils, hastening from the motor park at Bordeaux to the organisation's headquarters at Nevers, speeding a train of eight trucks over the roads of France in a mad effort to close up the four hundred-mile gap that lay between them and the approaching festivities.

A depressing mixture of snow and rain, oozing down from the grey heavens, casts a chill gloom over the landscape. Borden has been in France but two months. Neither he nor any of his men can speak French. But they have purchased an excellent automobile road map, and are fully confident they will have no difficulty in finding their way.

They would have proceeded with equal confidence to Timbuctoo.

The third day out finds them about half way to their goal. They have not loitered. Fluttering fowl, squawking in air along the roadside, testify that the governors on all the trucks have been disconnected.

The morning of the fourth day dawns clear and cold. Although they have taken the precaution to open all radiator cocks the night before, two or three of the cars are frozen tight.

It becomes evident at a glance that it will be necessary to requisition the services of a blow torch before the journey can be resumed.

But where to find the torch?

Four men are sent out on scouting expeditions in different directions. They soon discover that about the hardest article to describe in sign language, is a blow torch. It keeps them warm—not to say hot—doing it.

Borden himself, accompanied by a corporal, walks down the only street of the village, till he comes to a bicycle shop. In frenzied motions he converses for a time with the proprietor, upon whose face a light of understanding finally appears, for he leads the two from his shop down the street and into a large church.

"My God!" comes in an agonised voice from the corporal, "he's going to make us pray for it!"

But the corporal's surmise is wrong. Up the aisle proceeds the Frenchman, followed by the two mystified Americans. They come to a halt behind the antiquated pipe organ. Here the Frenchman, with a triumphant smile, points to a large bellows! Borden's motions have not been entirely wasted.

Sadly, but determinedly, Borden and the corporal turn

away, to continue their quest. Ultimately a blow torch is discovered. The trucks are thawed out, the party proceeds on its way.

About 9 o'clock, the train stops for a bit to allow the engines to cool down. The *patron* of a small café at a nearby roadside comes bustling over, oozing Yuletide hospitality at every pore. All hands 'round are invited to a *rum chaud.*

There is no authentic record in the history of the A. E. F. of such an offer ever having been refused, especially in winter. The party soon finds itself seated about a great fireplace, each with a glass of hot rum in his hand, and a rapidly maturing conviction that, after all, army life is not so bad at times.

Refreshments finished, the drivers are cranking their machines, when three venerable Frenchmen, each with long hair and flowing beard, make their appearance from nowhere in particular.

"What do you know about that!" exclaims one of the drivers, "don't they look like the Three Wise Men who journeyed to Bethlehem?" Even a chauffeur may once have been a star Sunday School pupil.

With many gesticulations, the patriarchs make it understood that they want a lift to the next village. Borden assigns each of them to a seat beside a driver, and, taking his place beside the driver of the leading truck, gives the "high sign," and they are off.

Half an hour later they roll into the next *ville* and stop.

Eagerly, the driver of the truck to which the oldest, hardiest and dirtiest of the trio has been assigned, approaches the Captain.

"Say Captain," he demands, "are those old Frogs going any further with us?" His face registers indignation, but in

his eye there is a pathetic appeal. "Because if they are," he continues, "I wish you'd give that old bird I had to someone else. He kissed me ten times between the café and here. Every minute or two he would give me a smack, and we were going so damn fast I couldn't take my hands off the wheel to defend myself. I just can't make him *compris,* but I don't want him along with me no more."

Despite these handicaps, however, the party reaches its goal in ample time for the celebration.

And a true Christmas celebration it is. For the 408th is not the only Bell outfit at Nevers. In the same town, quartered at the *Caserne Petie,* the 409th Battalion contributes its share of Christmas cheer and, what is more substantial and to the point, certain material accompaniments thereto. What with Bell Company funds forwarded from home, the combined party really outdoes itself in sumptuous festivity.

Some 150 kilometers east of Nevers, the 407th, its family scattered over a considerable area and pegging away strenuously on line construction, is endeavouring to enjoy its Christmas as best it may.

One little group is left completely without sustenance, the two companies having scattered in opposite directions and, quite naturally, having taken their respective kitchen outfits with them, leaving a small headquarters detachment behind.

This predicament is speedily settled by the establishment of a private mess in the house of a not unwilling native, whose wife is offered as chef to clinch the bargain. (Thus early in the game has the Q. M. established a reputation for succulent supply.)

As Christmas approaches, therefore, Corporal Knott, the self-appointed Mess President, takes on additional duties with ever-growing zest. The spirit of the season fills his

heart with Christmas cheer, and his inner man with well-defined yearnings in the direction of turkey, pudding and the like.

Unfortunately, fowl appears to be out of the question in this neighbourhood.

"But, now," reflects Corporal Knott, "roast pork—prepared as only a French madame can prepare it—that wouldn't go so bad." And yes, by George! what with the bacon grease yielded by Brother Hog, who is even now rooting contentedly and unsuspectingly in the neighbourhood of M'sieu's manure pile, pancakes, red-hot pancakes—which the corporal could make himself—with equally red-hot coffee,—would be just about the thing, Christmas morn, to take the place of *petit pain, confiture* and *chocolat.* And the more Corporal Knott thinks of it, the better he likes the idea.

He explains it to M'sieu and Madame.

That is, he tries to explain it. But his French still suffers from the common complaint: he speaks it in English only. Gestures, aided by samples of flour, buttermilk, etc., establish the batter all right; but the bacon grease—how can he make them understand *that?*

After thirty minutes of desperate dialogue, confined largely to pantomime, the corporal drops on all fours, casts his eyes upwards as if in silent prayer, and emits a series of grunts and squeals that brook no further doubt. Comprehension dawns upon the auditors, the perspiring martyr rises with a triumphant grunt, the cakes ultimately sputter on their appointed griddle, and the Day of Days is saved.

With the less scattered portions of the 407th family, however, the festivities are considerably more pretentious. The Christmas spirit, reigning supreme, has plenty of gastronomic support.

Into the heart of one officer, however (whom, out of respect for his feelings, we shall call Lieutenant Walden), Christmas cheer has found it difficult to enter.

For this officer has been expecting a certain message from home, and it hasn't come. Day by day he has awaited it anxiously, and day by day it has failed to make an appearance. Walden has fallen into the "dumps."

And now Christmas is at hand; faces are shining everywhere; tension has relaxed; voices have become more jovial.

The gloom has deepened in Walden's soul.

It was late in the afternoon, lacking but a few hours of Christmas eve, that a cablegram addressed to Walden finally arrived.

Walden had not yet returned to quarters. His brother officers, fully apprised as to the source of his worry, scrupled not to open the cablegram. The contents were read with delight. With one accord it was decided to suppress the message until the evening banquet.

The table that evening was enough to make the dullest eye glisten—except Walden's. The master of ceremonies had spared nothing—least of all, the wine. He arose to address the assembled diners.

"Gentlemen, I was about to propose a toast, but before doing so, I have an unpleasant task to perform. We have in our midst, I am sorry to say, an officer who has shirked his duty. He has particularly failed to support, in adequate measure, the manhood of the United States Army. I may as well announce at the very outset, that I refer to no other than Lieutenant Walden, who—"

Wrathfully, indignantly, Walden rises from his seat. He starts in the direction of the speaker. But the latter has

produced a cablegram,—everyone is grinning,—there is something mystifying about the whole affair——

Walden pauses, and the speaker continues:

"—Lieutenant Walden, who received, this afternoon, the following message:

" 'YOU ARE THE FATHER OF A BABY GIRL. THE MOTHER IS DOING WELL.' "

The announcement is greeted with a burst of cheering, under which Walden collapses into his seat, mechanically accepting the handshaking and shoulder-slapping. Suddenly he springs to his feet, radiant, as the master of ceremonies proposes the toast:

"Here's to Walden's new K. O.!"

There was more than the usual amount of rejoicing that night, and it would not be fair to lay Walden's condition to the wine alone. There is a cup which runneth over, far more potent than anything derived from the vineyards of France.

But a gala celebration is also held by our old friends of the 406th, Company D of which is quartered at Neufchâteau, and Company E at Marnay.

Nature has been sympathetic with the season. There is enough snow everywhere to suit the most ardent lover of a white Christmas, and the feathery flakes keep falling all day long. Santa Claus will have no trouble at all in the matter of reindeer transportation.

Splendid Christmas boxes from the Telephone Company back home have been arriving—bright augurs of the approaching holiday. Everyone of these boxes is labeled, "Not to be opened until Christmas." But our old friend Steve is affected with a watering mouth. The spirit is willing but the flesh is weak. Cannily, he decides to beat the game by opening and liberally sampling his package of good cheer

in advance. His eyes shine when he beholds the contents. There are eight items:

1. A pocket knife, capable of being put to innumerable uses.
2. A money belt, specially made, of finest cravenette, and capable of holding all the gold and bills likely to be lying around loose.
3. A stylo pencil, with extra leads, for writing home—and elsewhere.
4. A package containing a half-pound cake of chocolate, four assortments of candy, and two packages of chewing gum.
5. A pipe.
6. A tin of smoking tobacco.
7. Four packages of cigarettes.
8. A checker-board with checkers, dominoes, and cards.

Steve's immediate point of attack is Item 4. His mouth crammed full of good old American candy, he feels a sense of gratitude for the thoughtful ones back home which he would find it difficult to express.

(And, indeed, there is a story behind these Christmas boxes which probably will never be fully told. The story of the appeal to the Bell Company's employés for contributions, the more than generous flood of nickels, dimes, quarters and dollar bills that came back in response, the thousands of dollars thus collected from the rank and file, the untiring labours of the girl employés in putting up these packages that were to mean so much to the boys on the other side, the combination of artistic touch and efficient packing that insured safety and infallibility in transit,—

So impressed was President Vail with the job, that at a meeting of the Executive Committee of the American Telephone and Telegraph Company, when one of these Christmas boxes was displayed, the venerable head of the Bell System insisted upon having one, and made a reach for it.

"No, you don't!" came the jovial banter from F. H. Bethell, of the New York Telephone Company. "That box will cost you exactly twenty dollars."

Immediately Vail handed over the money, and one after another, the assembled officials tossed over a $20 bill and received in exchange the coveted Christmas box, the proceeds of which were immediately invested in smokes for the boys "over there.")

In the meantime, the lucky recipients of these gifts are wasting none of their spare time. They are doing things *con amore.*

On the day before Christmas, various sections have roamed the woods in the neighbourhood of the camp, and returned with many green boughs and huge branches of mistletoe, with which the dining-halls are decorated. The section chiefs have volunteered for the occasion to act as kitchen police,—conduct without precedent.

The entire night before Christmas is spent in roasting the huge turkeys and baking innumerable pies. Again the funds of the telephone employés back home are brought into play: the Q. M. has been able to supply neither enough turkeys, nor satisfactory "fixings" for a real Christmas dinner.

Early Christmas morning, the men from headquarters and Company E import an American Papa Noel, or Santa Claus, into the village of Marnay, for the special benefit of the children. A real American Christmas tree has been rigged up in the school-house. It is heaped with toys and glistens with the whitest of snow (obviously derived from the private stores of cotton in the Medical Officer's dispensary).

A crowd of eager-faced youngsters has shown up. (The men of E Company thought they knew all the faces in Marnay, but a dozen or two new little faces, from which stare

wondering eyes, have made their appearance. Clearly Christmas news travels fast in the neighbouring villages about Marnay.)

And such a happy racket! The little school is filled with chattering, vivacious youngsters, some of them viewing a Christmas tree for the first time in their lives, others for the first time in so many years that they have completely forgotten what it looked like.

The ceremony opens with a simple little speech by one of the youngsters, which it would be difficult to improve upon:

> The children of Marnay wish to thank you. We like our presents very much. We like you very much. We feel that God has sent you here to fight alongside of our fathers and brothers. We therefore welcome you as if you were our own fathers and brothers. We hope that the children in America, who, like us, are deprived this Christmas of their real fathers and brothers, will be as fortunate as we are to-day. We ask our Saviour to bless and comfort them as He has blessed and comforted us. We thank you very much.

And then comes the great excitement.

The smallest tots are led to the tree to pick their presents. It is a joyous spectacle, worth going miles to see. The older ones follow—a trifle bunched and crowded, at first, but gradually brought under control on a single-file basis.

There are enough presents to go around twice, and enough horns to make fully twice as much noise as the room can hold.

In the meantime, Suddath has collected all his E Company cohorts at Marnay, work being suspended both by the Frecourt detachment, which has been pushing the Langres-Neufchâteau line northward, and by Foust's crews, which have been engaged on a big job in the Chaumont artillery barracks.

Those who can be spared from the exchanges at headquarters and Langres, also wend their way joyously toward Marnay.

At noon, E Company and the battalion headquarters detachments are jubilantly assembled in the little messroom. Evergreens and lanterns festoon the walls and ceiling. The white tables (clean linen!) are strewn with fruit and nuts and smokes.

The memory of that feed must always linger. The mess sergeant, who has been registering steady improvement since taking over E Company's mess, has put over the meal of his life. For three solid hours, healthy soldiers, fresh from the rigours of outdoor construction, continue to stuff away an endless supply of turkey and cranberries, more turkey and more cranberries, sweet potatoes and pies.

In the meantime there is another real party at Neufchâteau, where D Company of the 406th has collected all its men except those who must remain at the various switchboards, telegraph keys and testing stations.

All battalion officers are invited to dine with D Company. Hubbell, now at General Headquarters, is included in the party, and the happy family is together again. Just about the time for dinner, the Chaumont detachments arrive, bringing with them a bursting batch of mail, which is quickly distributed, lending new zest to the sumptuous banquet awaiting the diners.

Again the holiday spirit plays havoc with rank; the sergeants have volunteered to serve all the tables, and a busy time they have of it, trying to keep the diminishing mess kits filled with turkey and cranberries, potatoes and gravy.

Then comes the climax. A letter of greeting from L. H. Kinnard, of the Bell Company back home, brings welcome

news of new pay arrangements. This message draws wild cheers from the men, many of whom have been vaguely wondering just how they and their families were going to meet a future that held out little promise of an early cessation of warfare.

The small end of the afternoon arrives, and the party, perforce, breaks up. Even Christmas can hold up war's requirements for but a limited number of hours. It is time for the men to go back to their jobs.

The officers, too, have a strenuous job ahead of them—although the men can't see it that way. And yet theirs, indeed, is the greater responsibility; for they must eat another dinner. They are invited by the battalion staff at Marnay to participate in a dinner given to the officers of the battalion. It is 5 o'clock and still snowing hard. After traveling some 70 kilometers through the blinding snow, the officers, clad in snowflakes several inches thick and looking for all the world like military editions of Santa Claus, finally arrive at the little café at Marnay, where their brother officers—and another enormous meal—await them.

Duty is duty.

The meal is encompassed successfully, punctuated throughout by just enough wine to keep the conversation rapid and the singing mellow. At 10 o'clock, D Company's representatives, having in mind their long and snowy trip, prepare to leave, much against the protestations of Hubbell,—protestations which, now that this officer is no longer in command of the battalion, are unavailing.

As Griest and Hasskarl step out into the snow, which now glistens in the Christmas moonlight, they behold the pale apparition of a crippled *poilu*.

"Probably home for Christmas," observes Hasskarl, as he

steps into the car. "Poor beggar, I wonder what he would appreciate most from old Santa?"

"Peace, probably. With victory, of course."

"Yes, with victory. But I wonder how long Santa will be in coming around with that particular package. The Bolsheviks, I hear, have concluded an armistice with the Central Powers, at Brest-Litsomething-or-other. That puts the Russians out of it for good. Wonder what kind of a Christmas present they expect from the Hun?"

"Well, whatever they expect, they're not going to get it, that's certain."

"Wonder what kind of a present General Russel got in the box he received this morning? He looked tickled."

"Well, I know what he was looking for."

"Yes, I know it too. About 5000 tons of signal supplies."

Silence ensues. They are thinking of the same thing.

CHAPTER XX

F. O. B. FRANCE

"THAT is all very well," the average reader is likely to say to himself, "about those heroic measures, those interesting examples of American ingenuity, brought about by the absence of telephone and telegraph supplies during the early days of the A. E. F., but—why the absence of supplies?"

We read of the early handicaps to telephone and telegraph construction in France; of the original telegraph battalions, utterly unequipped for construction, forced to beg, borrow or steal such flimsy tools as they could. We read how they broke their backs and blistered their hands in an effort to dent unyielding rock with the soft steel of the French digging bar. We read of McReady with his "child's toy fastened to the end of a broom handle," of Fay and his ingenious contrivances for constructing workable duplexes out of haphazard electrical equipment picked up in Paris shops. And we naturally wonder, Why all this delay in shipment of telephone and telegraph supplies?

It was an oft-repeated question in those early days of the A. E. F., from General Russel down to McReady with his biscuit-tin shovel.

It is all the more a natural question, when we consider what a splendid supply system the U. S. Signal Corps ultimately perfected. It was in very truth a marvel of dispatch and efficiency. Evenly oiled and moving without a hitch,

it gathered up at home, from a thousand sources, amazing quantities of infinitely varied and highly specialised signal equipment—from poles to rat-proof pigeon cages, from accumulators to vacuum tubes, from flashlights to field telephones, from batteries to brassards, from motor trucks to moving picture films—insulators, tape, twisted pair, linemen's tools, radio equipment, what not; and these were kept pouring in a steady and evergrowing stream across the Atlantic and into France where, under General Russel's nicely grooved system of A. E. F. supply, they moved without delay from base ports to depots, from depots to parks, from parks to every point in the A. E. F. where the need arose.

But 'twas not like that in the early days. Far from it.

Not that Russel failed to realise the vital importance of ensuring an adequate signal supply system in France. He was keenly alive to it, in fact. At the very outset—back in May, 1917—he had wasted no time in consulting the experts and framing his list of telephone and telegraph supplies for the originally planned "400-mile line." He had sensed very clearly the possibilities of impediment to supply that lay in the vast 3000-mile gap separating his home base from his base of future operations. He saw, with all the distinctness of an executive endowed with vigorous imagination and foresight, that unless he arranged for his supplies amply in advance, he might find himself in a serious predicament before many months had elapsed.

It was because Russel belonged to the "Bird-in-the-Hand-Worth-Two-in-the-Bush" school of philosophy, that Pershing had chosen him for his Chief Signal Officer. It was quite in accordance with the tenets of this pragmatic school that Russel should have contrived, just before his departure for France, to seize upon the two Western Electric switchboard

units and the two dozen poles that he found he could "get away with," and stow them into the hold of the *Baltic.* against exactly such an emergency as later arose when Pershing moved his headquarters to Chaumont.

And it was due to the same sense of prevision that Russel, instead of doing the orthodox thing and waiting until he got to France, determined to start the wheels of supply before he had left his native shore.

Just before his departure, therefore, he hastily pushed through his requisition for telephone and telegraph supplies, based upon estimates made up by Hubbell and his associates in The Bell Telephone Company of Pennsylvania, and by the experts of the American Telephone and Telegraph Company.

This requisition included "central office equipment" for four toll test boards, certain multiplex printing telegraph apparatus, telephone repeater equipment, and a large quantity of line and construction material for the "outside plant."

All this was for the "400-mile line"—the order for the "265-mile line extension" was not placed until several months later.

When Russel left for France on the *Baltic,* it was with a feeling of assurance that everything from the supply standpoint had been done that could be done. Had he not personally seen his requisition "take legs," on its way to embodiment in the form of manufacture and shipment? His mind was free on that score.

It was not until the latter part of August—three months later—when Hubbell and Shearer, representing the newly arrived Bell Battalions, reported in person to Russel at Paris—that Russel learned to his dismay that work on his

requisition for supplies had been held up for several precious months.

For this "requisition of May 27th," as it came to be called, was doomed to a series of unfortunate vicissitudes.

It started brilliantly. Its call was anticipated at the source of manufacture.

Major Jewett, it will be remembered, had been stationed by the Chief Signal Officer for duty with the organisation of which he was Chief Engineer—the Western Electric Company—the largest manufacturer of telephone and telegraph supplies in the world.

Jewett seized time by the forelock. His organisation immediately got to work, putting its men on day and night shift in order that the telephone and telegraph needs of the American army in France might be met fully and promptly, insofar as it lay in their power to ensure that this was done.

And then came a hitch.

The office of the Chief Signal Officer, by way of caution, addressed a cable to the American Embassy in Paris, requesting them to ascertain more exactly the French situation as to telephone and telegraph supplies.

The military attaché at the American Embassy called upon the French military authorities, and was blithely assured that existing telephone and telegraph facilities in France would be ample for the American army. No worry need be had on that account—*pas de tout.*

It would be easy, but unfair, to heap censure upon this informant for his optimistic reassurance.

For it must be remembered that the French telephone and telegraph system was such as to convey not even the remotest conception of the size, completeness and standard of

perfection maintained by the telephone and telegraph system in America, and the consequent standard of electrical communication that the American army would insist upon when it came to fight in France.

Nevertheless, a letter dated June 11, 1917, from the office of the Chief Signal Officer, based upon this assurance from the French Government, and signed by Major—later Colonel—Charles S. Wallace, was forthwith addressed to the Western Electric Company, advising "that this office has just received information from abroad that the present telephone and telegraph lines between the proposed Port of Embarkation and advance posts are adequate and it is, therefore, recommended that no further steps be taken by the Western Electric Company to assemble the line material and equipment for the trunk lines for the United States American Expeditionary Force as shown on the list compiled as a result of a conference between Colonel E. Russel, Signal Corps, and Major James W. Hubbell of the Bell Telephone Company."

Immediately all work was stopped on the telephone and telegraph supplies intended for Colonel Russel's "400-mile line," and it was not until nearly two months later that this work was resumed.

Never did mariner, shipwrecked on a desert island, gaze more anxiously out to sea for the sign of a sail, than did the sergeant left by Russel at the base port for the purpose, anxiously scrutinise every incoming transport for signal supplies from home.

By the fall of 1917, however, the Western Electric Company, having been permitted to resume work on Russel's original order of May 27th, had completed the equipment for the originally designed "400-mile line" and had for-

warded it from its Hawthorne plant to New York, ready for shipment overseas.

And here came Hitch Number Two.

A new requisition from the A. E. F., with the revised specifications for an augmented long lines programme mapped out by Howk in Chaumont, had arrived in Washington.

In forwarding to the Western Electric Company the requisition and specifications as prepared by Howk in the A. E. F., the Signal Office at Washington, through Major R. M. Jones, advised that these had been accompanied by a letter from General Russel dated October 16, 1917, but omitted at the time to forward a copy of that letter, presumably because it was felt that the communication was of no concern to the Western Electric Company.

The letter itself was pertinent—most pertinent. For in that letter Russel made it clear that "This material is required *in addition to the material asked for in our requisition of May 27.*"

It was an important qualification. But in its absence, with nothing to go by except the specifications submitted for a new and enlarged programme of communications in the A. E. F., there could be no other interpretation, of course, than that this new programme was to *supersede* the original programme for a "400-mile line," and that, in consequence, the new material ordered was to take the place of the old.

There followed immediate and wholesale adjustments to the material awaiting shipment overseas, to conform to the new requirements.

The new requisition arrived at the Western Electric office on November 22, 1917.

The author has before him a striking chronological journal. It is posted almost on an hourly basis. It traces the

steps of certain Western Electric engineers assigned to following up the new A. E. F. requisition, beginning two minutes after its receipt, and concluding with the completion of the job several weeks later. Being neither a mathematician nor an engineer, the author is at a loss to puzzle out exactly when and how, during this interval, these men did their eating and sleeping. To say that they worked at the task feverishly, would be but a platitudinously inept characterisation of their unremitting efforts.

And the job of engineering, accumulating and shipping this material was not dropped until the last box had been dispatched to France.

But before the final dispatch of this equipment was accomplished, a certain amount of additional delay was encountered at the Port of Embarkation.

Let us assume you are utterly unfamiliar with the contents of a timepiece. You know, of course, that it contains an assortment of wheels, springs and tiny gears, but beyond that your knowledge extends into blank space. And then suppose you were suddenly presented with a pile of these "innards," and asked to pack them together into hundreds of cases so that they could be immediately assembled into watches at their destination several thousand miles away.

It would "give you pause," to say the least. It would also give you something of an idea of the task thrown upon the Signal Corps officer in charge at the Port of Embarkation, when the line of communications material was delivered to him by the Western Electric for shipment overseas.

For this equipment included the widest assortment of specialised apparatus—test boards, cable wiring, terminal racks, multiplex printing telegraph machines, repeaters, and

the like. Only the specialists familiar with their manufacture and use could possibly be expected to know how to arrange the thousands of parts intelligently for shipment.

And they were all intended as specific parts of a comprehensive design. Unless the apparatus was co-ordinated, boxed and shipped so that it could be installed exactly as and where intended, in accordance with the new scheme of communications mapped out for points "A," "B," "C," "D," "E" and "F" in France, the "whole works"—or at least an essential part of it—might go astray in the confusion that would be sure to follow.

E. B. Craft was then a Captain and later a Major in the Signal Corps. He was also an official of the Western Electric Company, and one of the most level headed of the younger executives. He saw very clearly that—Army Regulations to the contrary notwithstanding—if this material was to get to General Russel without further delay, and without danger of absolute demoralisation in checking up and installing the apparatus on the other side, the Western Electric experts simply *must* add to its task of manufacture, the additional task of boxing, marking and preparing the apparatus for shipment overseas.

And again the broad, pragmatic policy of the Signal Corps under General Squier came to the fore. This was War, which stands not upon ceremony. The Western Electric was given the word to "go ahead and do the job yourselves."

They went ahead. Under the direction of E. D. Hall of the Western Electric Company, a system of packing and shipment was worked out that was as nearly fool-proof as human ingenuity could make it.

The material was assembled in cut-and-dried form: into the box it went—on went the lid—loaded into the transport—

arrived in France—off went the lid: and by reading the directions, the A. E. F. signal engineers who, back home, had already been quite familiar with the apparatus, were enabled to save incalculably precious time in putting the apparatus in working order.

Each box, in addition to the Signal Corps order number painted on the outside, was lettered to correspond with the letters "A," "B," "C," etc., of the new scheme of A. E. F. communications, thus almost automatically directing each unit of equipment to the point in the general scheme for which it was intended.

Invoices showing clearly each box number and date of contract were made out for each and every shipment from the Signal Corps warehouses, after it was first made certain that all kindred equipment was assembled together.

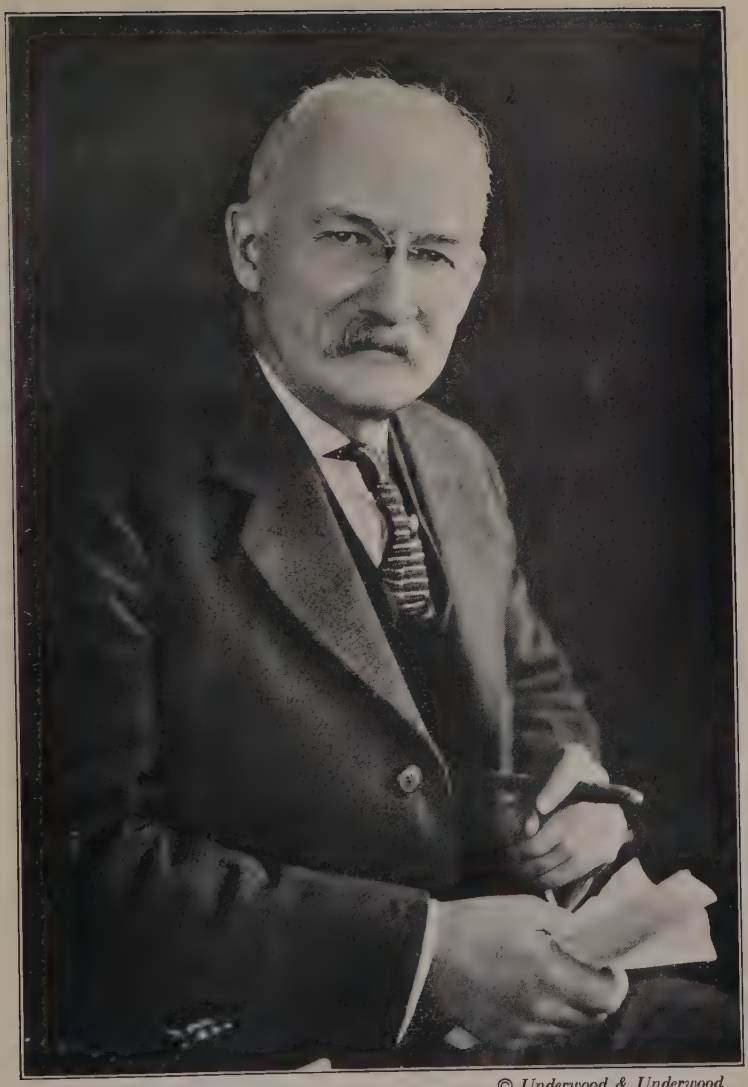
Then, still further to assist the Signal Corps men in the A. E. F. to co-ordinate and install the various switchboard units, detailed "identification specifications," as they were called, together with careful drawings, were prepared and sent along with each shipment in a special box, painted black for easy identification, and bearing the words "INSTALLING INFORMATION" in large white letters painted on each of its six faces.

Finally, as additional rivets in the fool-proof machine, four extra copies of these identification and installing specifications and drawings were in each case mailed to Washington,—two to be forwarded to General Russel by one boat, and two by another.

The material simply *couldn't* go wrong, except—

Except, of course, if it were sent to the bottom by a German submarine.

And to minimise the effect of this contingency, the ma-



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HARRY BATES THAYER

War-time president of the Western Electric Company, and Mr. Vail's successor as head of the American Telephone and Telegraph Company.



VOICES IN THE SKIES

President Wilson talking to airplane pilot over wireless telephone. Insert: Pilot and observer using the Western Electric intercommunicating set to talk with each other while in the air.

terial was so assigned to different ships that the project for which it was intended would not be seriously delayed if that particular ship were sunk.

"Having a definite record," as Hall explained, "of just what material went on each ship, we knew that in the event a certain ship were sunk, a cablegram or radio message informing us which ship it was that went down, would permit us to proceed at once to duplicate the exact material that was lost."

Providence was kind. Practically none of this material was lost. Later, toward the summer of 1918, when losses in Signal Corps material did occur, they were of relatively small advantage to the Kaiser. For the damage to the cause of militarism, insofar as the A. E. F. Signal Corps was concerned, had already been largely done.

But during the first seven or eight months of the A. E. F., the boys who planted the poles and strung the wires and did the pathfinding and foundation-laying for the magnificent system of electrical communication that ultimately came into being, naturally found the handicap of inadequate tools and equipment a grievous one.

To an appreciable extent, the harried French assisted bravely to overcome this handicap. But their own need was, of course, a sore one, and dearth stalked everywhere.

There was a strange oasis in this desert of dearth. It had been planted years before, when war was undreamed of. Its name was *Le Materiel Telephonique,* situated at 46 Avenue de Bretuil, Paris.

The "planter" was the Western Electric Company, whose Paris branch, *Le Materiel Telephonique,* now came unexpectedly to the front.

For while the shop men of the Western Electric Company back home, in response to the request of the Signal Corps office at Washington, were holding off on Russel's original order, the sales force of the Western Electric branch at Paris were struggling under a veritable deluge of demands made upon them by Russel's eager group of pioneers.

The Manager of the Paris branch, J. S. Wright, wrote to the Manager of the London branch of the Western Electric:

> The Paris House is in the throes of the American invasion of France. It would have been difficult to find one-half hour during any business day of this week, when there was not at least one representative of the Army either in the offices, or telephoning to us.
>
> The Signal Corps, the Engineering Corps, the Aviation Service, the Q. M.'s Department, have fallen upon us, and up to the present time, we have been surprisingly successful in satisfying their many and divers wants.
>
> We have sold them all the samples of line material (Buffalo grips, climbers, shovels, spoons, etc.) which we purchased from New York two years ago, and could have sold many times the quantities which we had, if they had been in stock.
>
> Besides the Fullerphones, and the 250-line exchange, about which I have already written you, we have had inquiries for all sorts of miscellaneous articles, many of which we have been able to buy outside. To-day we have been asked to quote on sewing machines among other things, and Castler is out this afternoon trying to find 400 pairs of linemen's gloves.
>
> In the midst of all this, Captain Paddock arrived yesterday morning unexpectedly from Chaumont to inspect the Fullerphone[1] model, which was finished this morning; he was present

[1] The English Fullerphone, as redesigned by Paddock for the American Signal Corps, was known as the buzzerphone (not to be confused with the army service buzzer, previously in use by the American Army). The buzzerphone obviated the possibility of messages being read by the enemy, because, unlike the telephone and the army service buzzer, the current sent over the line, in addition to being of very small magnitude, was a direct, instead of alternating current, and, therefore, did not induce current in parallel or adjacent wires,—thus preventing the enemy from "listening-in."

at the very first test which we were able to make and it was an unqualified success. He is more than delighted with it and will take it back with him to-morrow to show to Colonel Russel and General Pershing.

I am sure you would be pleased to see for yourself what satisfactory relations we have established with the Army, and one of the most pleasing features of it all is the enthusiasm with which every member of our staff, including especially some of the foremen, have taken hold.

Later came Fay and his group of telegraph experts. Again, as will be recalled, the Paris branch of the Western Electric came to the rescue by placing its precious cargo space reserved on the French steamship lines at Fay's disposal for direct order and shipment.

But Fay was not the only beneficiary. At least 95 per cent of this space was taken up by Pershing's aggressive Engineering Corps, whose order was placed direct with *Le Materiel Telephonique* for the same reasons that confronted the Signal Corps.

In a few months preceding, Wright's shelves and bins had been swept as clean as Pharaoh's fields after the onslaught of the locusts.

"Nothing left in stock," he had been forced to apprise the Army authorities; "but you know, of course, we not merely sell, but *make.*"

"Can you make *these?*" Fay's list was modest, compared to that of the Engineers, whose requirements included a veritable mountain of electrical supplies,—lamps, bulbs, sockets, reflectors, and the like,—tons upon tons of them.

"Of course we can make them—back home."

"How soon?"

"How soon?" cabled Wright to New York headquarters.

"Ten days," came the response.

"Ten days," repeated Wright.

"Go to it!"

Wright went to it. So did the Western Electric Company back home: New York headquarters, and the Hawthorne plant.

The promise was kept to the letter, the material shipped direct—and before very long it was pounced upon by the Staff Officers and put to work.

The recipients, of course, busied with their own A. E. F. troubles—and they were sufficient—had little conception of what it had meant back home "to get the stuff to them p.d.q.," as they had requested.

"The sessions were from morning to midnight," relates Craft. "We just couldn't keep those fellows away from the job, they went after it so plumb crazy."

Of course they did. The minds of these men were in France as they worked. The fire of patriotism had been kindled, and was blazing brightly at every hearth, in every shop and factory in the land.

But there was more than patriotism in back of the effort of these men. There was patriotism applied under exceedingly effective circumstances, under circumstances of such interest to all who are proud of America's genius for organisation that they may well form a chapter by themselves.

CHAPTER XXI

"BRUTE SUPPLY" AND THE WESTERN ELECTRIC

Spectators love the spectacular. Readers search for the dramatic. There is much of both in the war story of the Western Electric Company, which enjoys the distinction, together with the American Telephone and Telegraph Company, of being a corporation actually decorated by the United States Government for distinguished services in the World War. And yet the most significant contribution of the Western Electric Company was neither spectacular nor dramatic. It consisted in supply—"brute supply," as General Russel, in the early days of the A. E. F., described his chief need to Colpitts shortly before the latter's return to the United States.

Amazing, without doubt, was the development by Western Electric engineers of the wireless telephone, permitting aviators to converse with one another and the ground. Equally amazing were some of the anti-submarine devices produced by these wizards of applied electrical science. Their sound and flash ranging apparatus for detecting the exact location of hidden gun emplacements, or of hostile aircraft maneuvering in the dark, are nothing short of uncanny, eclipsing the most fantastic dream-conceptions of Jules Verne.

But over and above all these, stands the bread-and-butter-and-beef significance of the Western Electric organisation; the prosaic but immensely important fact that we had in

existence, in this country, a potential source of Signal Corps supply that literally flooded the A. E. F. with electrical communication; that was able to produce as many telephones in one year as the Kaiser's Imperial Telephone Administration had been able to produce in a decade; that actually manufactured and shipped overseas sufficient equipment to install over four hundred "central offices" with a capacity for more than 30,000 lines, to say nothing of 50,000 portable camp sets of earlier design, 40,000 field telephone sets of later improved design, hundreds of standardised, omni-adjustable, sectional switchboard units, and over 200,000 units of interconnecting apparatus,—the first 50,000 of which were rushed through in six weeks.

It was a tremendous reservoir for Uncle Sam to draw upon in his time of need.

But it was a reservoir not so much of existing supplies—for these had been largely eaten up by the abnormal world market of the preceding few years—as of trained personnel knit together into a superb organisation *capable of producing* the needed supplies with surprising speed and in abundant quantity.

It is here that we find the chief handicap suffered by the French and British in the matter of electrical communication.

Now, contrary to a certain tendency toward self-satisfaction, it is a fact that French and British engineers are in no way less ingenious than our own. Indeed, some of their signal devices developed during the war are marvels of mechanical and electrical ingenuity.

But neither England nor France had anything like our huge organisation reservoir of standardised telephone and telegraph equipment to fall back upon; so that when the

great emergency came upon them, it was a case of rounding up all the miscellaneous, heterogeneous apparatus lying around loose, and "shooting" it to the front.

And what a collection! "Standardisation" was the last word you would have thought of, in connection with that apparatus. There was scarcely a single, up-to-date "common battery" system in the entire lot. British Signal Officers were later amazed to learn that the United States had available, at the Western Electric plant in Hawthorne, outside of Chicago, *sixty acres of floor space* devoted exclusively to the manufacture of telephones. And as for the French system, George Ade's peace-time characterisation still held good, with a double, war-time vengeance: "Anything you see on the wall of a French home is apt to be a telephone—if it isn't something else."

Both the French and the British fully realised the importance of standardisation in matters of electrical communication. But with the French it was a case of "Could not," and with the British simply a case of "Did not."

A number of years prior to the war, the engineer in charge of the French Department of Postes and Telegraphes recommended a standardisation in telephone and telegraph equipment, especially in relation to an improved type of telephone instrument. The recommendations were at first approved; but before they could be put into practice, a tremendous amount of political pressure was brought to bear upon the government authorities by the large number of individual manufacturers responsible for the multifarious character of French telephone and telegraph equipment, and this effectually squelched the proposed improvement. It also squelched the engineer who suggested it, for he lost his position shortly thereafter.

The British were equally alive to the importance of standardisation. When Colonel Hubbell, of General Russel's staff, visited the British front at Vimy Ridge in January, 1918, for observation and instruction, the universal injunction from British Signal Officers was, "Don't fail to profit by our mistakes: Standardise!"

But standardisation in the American Signal Corps was a foregone conclusion, because the process had begun long ago in the commercial field of electrical communication.

Not that this standardisation was in any way a forced one. It had come about, as a matter of fact, in the most natural way.

Vail's organisation, including the associated Bell operating companies, had discovered very early in the day that the manufacturing electrical organisation founded by Gray and Barton back in 1869, incorporated as the Western Electric Manufacturing Company in 1872, and reorganised as the Western Electric Company in 1881,—could "deliver the goods" by virtue of a quality of workmanship, economy and dispatch that had spread its reputation and its trade to distant corners of the world.

For the Paris and London branches of the Western Electric which rendered such timely assistance to Pershing's pioneer army, were by no means the sum total of the Western Electric Company's international organisation.

As early as the winter of 1879-1880, in a day when American export was still a matter of raw materials and food, Barton, one of the Western Electric founders, had broken precedent and journeyed to Europe to lay the foundations for American manufactured product abroad. Out of that visit rose the Western Electric factory in Antwerp, built in 1882, and the earliest Bell exchange in Europe, established when

the first multiple switchboard was built and installed in that city in 1883. This new aggressiveness in American manufacture, the Western Electric continued to follow up. It built and installed the first switchboard ever used in Japan, and made and set up the first common battery exchange in China. By the outbreak of the World War, the Western Electric Company had established branches not only in England, France and Belgium, but also in Holland, in Italy, in Norway, in Switzerland, in Russia, and in the Orient, including both China and Japan,—not to mention Canada, Australia, the Argentine Republic and South Africa.

The same qualities that led to this marvellous world-wide growth—economy in manufacture and excellence in workmanship—also led to the unique and special relationship which grew up with the various Bell telephone companies in the United States.

For soon the Western Electric Company came to occupy the position virtually of a manufacturing corporation for the Bell System—an arrangement found indispensable to every enterprise which requires the manufacture, for its own use, of highly technical and continually changing equipment in such variety and magnitude that it could not possibly be procured in the open market.

And there lies the secret that has puzzled so many foreign observers.

"We are not prepared to admit," they say, at least impliedly, "that your engineers are more capable than ours. But," they candidly add, "we simply cannot but recognise that your telephone engineers are far ahead of us in every phase of the art."

The superiority is wholly institutional, not personal. Brains are cosmopolitan, not bounded by national lines. It

is in the system that the superiority in American electrical communication lies.

For there ensued, within the Bell System, an intimate co-operation between the operating companies, the technical departments and the manufacturing company, which could not but ensure that every possible improvement in apparatus from the operating point of view, every possible perfection in the art that all these factors converging on one point could suggest, would be ultimately embodied in the output.

The result was inevitable. American electrical communication stood head and shoulders above any other similar system in the world. With less than 6% of the world's population, America had more than 60% of the world's telephones, and this system was largely supplied by the Western Electric Company, the greatest system of its kind the world had ever known.

It was this system, with its stupendous facilities for highly refined, highly specialised and highly varied instruments of production, that was now turned loose upon the business of war in the interest of civilisation.

The Signal Corps, naturally, found it a tremendous foundation upon which to build. But it was more than a mere foundation. It was a going concern, organised and equipped so as to marshal, in record time, a quantity and variety of technical apparatus that in no other way could have been brought to bear with such timely and telling effect upon the final result.

Now, no nation in the world has anything like this. It will therefore be of more than national interest to relate further the story of how this interesting organisation functioned during the war.

It has been the theme of poets and romancers that some day there would arise in our midst a man of colossal mental stature, who would combine in one person the intellectual daring of a Galileo, the executive force of a Napoleon, and the inventive genius of an Edison, a Stephenson, a Bell, a Morse, a Marconi, a Wright,—all rolled into one.

Poetic fancy: that is the way the dream has impressed us. And yet, did we not approximate this dream in practice when, during our great mobilisation against autocracy, we concentrated a brilliant national army of executive and inventive talent so that it could function through the mind and speak through the lips of a single person—the body corporate of the United States of America?

Something of the same idea must have suggested itself years ago to Theodore N. Vail, when he laid the foundations for that Many-Minded Inventive Intelligence which later came to be designated in certain circles as the Corps of Inventors: the most remarkable group of scientists ever assembled under a single roof for continuous co-ordination of effort: physicists, chemists, electrical engineers, mechanical engineers—graduates and former professors from a hundred different institutions in different parts of the world.

Now the popular conception of an inventor is that of a cadaverous party with a far-away look in his eyes, who puts his finger to his forehead and suddenly cries, "Eureka! I have it!" Whereupon a brilliant invention drops out like a stick of gum from a slot-machine.

There was certainly nothing of this in the "Invention Corps." It is doubtful whether you could point to a single one of those marvellous devices produced by the Western Electric Engineering Department, and say of any one of the engineers who made it possible, that *he* was the inventor.

No one man could have invented it. No one man could have planned it, designed it, tested it and put it on a productive basis in time to count against the enemy.

Let us suppose the Signal Corps wants a new signal device—absolutely different from anything of the kind in existence. The device is to accomplish certain objects. Hence the Signal Corps submits its specifications to the Western Electric Company. (These, not unnaturally, are often vague in the extreme.)

Now, it must be remembered that for each new military device called for from the Western Electric, there were two distinct problems:

First: To create the delicate, tender *fetus,* and

Second: To develop, toughen, train and educate it to a stage of ruggedness and "fool-proofness," so that it could withstand the rigours of military service.

And so, as soon as the Signal Corps has submitted its specifications, they are "shot over" by the receiving engineers to the "fundamental planning" engineers.

These, having laid out the fundamental plans, "shoot them back" again, whence they go to the engineers in charge of designs.

Designs being made up, they go at once to the laboratory for testing.

A hard clan to please are the laboratory engineers, and the designs may have to go back for re-designing, then for retesting.

Finally, the laboratory test completed, a model emerges satisfactory to all concerned, and this, with the specifications and drawings, is "shot" out to the manufacturing department at Hawthorne (Illinois).

There a committee of manufacturing experts bear down

upon the model and specifications, with a view to deciding upon the best, most economical, and most speedy method of manufacture.

This may mean new recommendations for change in design, to facilitate manufacture, to strengthen the apparatus, or to make it work more positively and unfailingly.

The manufacturing department must now design and make tools, put them into actual operation in the regular departments, and assemble a model—called a "tool-made sample" —from the parts made up by these tools.

This "tool-made sample" goes back to the engineers for approval, and if the engineers are satisfied, manufacture begins.

Deliberate and painstaking as these steps necessarily are, the special war devices called for were sometimes rushed through with a speed that was phenomenal. For instance:

1—On Saturday morning, September 7, 1918, Colonel J. W. Mauborgne of the Signal Corps, stationed at Washington, presented to Lieutenant-Colonel Jewett, stationed at the Western Electric Company, the problem of designing a local battery set to be used in connection with the fire control of anti-aircraft batteries.

2—By Monday evening, September 9, a set, complete in practically all respects, was finished, and the same evening taken to Washington for inspection by Signal Corps officials.

3—Early the following morning, the apparatus was submitted to Colonel Mauborgne, who in turn took it up with Major-General Squier.

4—By noon of that day, the necessary tests had been made by the Signal Corps and approval given.

5—This left the Western Electric organization free to proceed with the manufacture of the set. The model was taken to Hawthorne at once by the engineer, and presented about 10:00 o'clock the following morning for manufacture.

6—By October 25, or 48 days after the first request had been

made, the "tool-made samples" of the set had been approved and deliveries started.

This was speed with a vengeance, and Major-General Squier could not refrain from wiring Jewett to this effect:

Your prompt action in devising in a few hours a special type of anti-aircraft telephone now needed for immediate production for our overseas forces has just been brought to my attention. This is one more evidence of the splendid efficiency of the Engineering Staff, both technical and mechanical, of the Western Electric Company.

But this confidence of the Signal Corps in the Western staff at times proved embarrassing.

"They think we can do anything," one of the engineers complained, "because we've never yet turned them down on anything. They're getting pretty close to the impossible. And I suppose when they get to that, there'll be nothing for us to do but raise the ante and come across."

One bright young engineering chap in particular refused to be stumped by any proposal, however weird or fantastic. Had you asked him to design an instrument for conversing with the angels, he would merely have asked, "How soon?"

On one occasion, indeed, a proposal very little short of seraphic intercommunication was put up to him for solution.

"How soon?" he queried, as usual.

"Two days," was the response—as usual.

"All right," he said cheerfully, and got to work. He hadn't the slightest notion how the thing could be done.

Now it should be mentioned that when the engineers finally arrived at their specifications, they usually forwarded these to Hawthorne on a "Specifications Form," enclosed in a "Specifications Folder." If, after the specifications went

forward, additional ideas suggested themselves to the engineers, they would be forwarded in a supplementary folder as an "Appendix."

On this occasion, our engineering friend was simply "up against it." His brother engineers vowed "it couldn't be done." To the confident rejoinder that the "Specifications Folder" would go forth in two days, they opposed a collection of substantial wagers.

Promptly on schedule time, the folder went forth. Skeptical voices were hushed. The indomitable young engineer collected his bets.

And the next day, a red-hot wire came sizzling back from the manufacturing department. There was anguish at Hawthorne, and no small amount of indignation.

For when they had opened the "Specifications Folder," they found a "Specifications Form" duly enclosed—*absolutely blank* except for the words: "DETAILS TO BE FURNISHED IN AN APPENDIX."

"Midnight maniacs" was one of the war-time appellations locally earned by these engineers; particularly with the auditors of the Western Electric Company, who simply threw their hands up at "the crazy combinations of junk" these engineers were likely to order for their own use.

"Now here's an item, Coffee Percolators," growled one of the auditors one day. "What in Sam Hill do you suppose they wanted those things for?"

"Haven't the slightest idea. Call 'em up and find out."

Inquiry developed that these "instruments" were wanted by a special detail of engineers required to spend days and nights on submarine patrols, adapting and testing their specially designed anti-submarine devices.

"But what on earth have coffee percolators to do with submarine detection?" was the puzzled inquiry.

One of the "midnight maniacs" enlightened him.

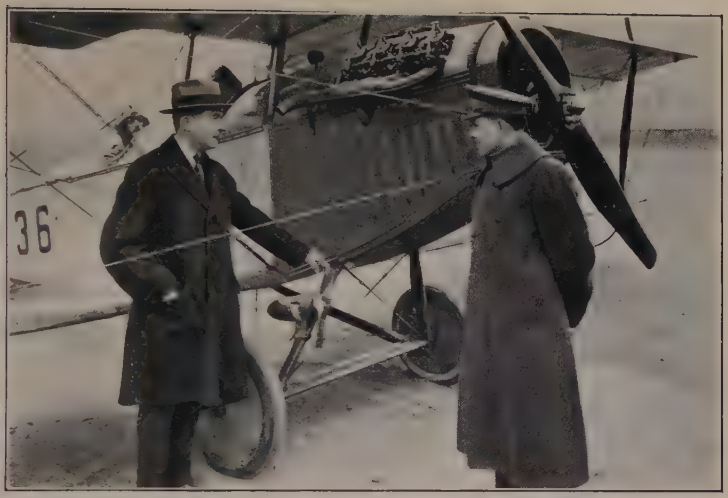
"*You* try to keep your 'think-tank' going on that job after midnight, on a rough sea, with the thermometer registering 5 below, and see how far *you* get without coffee."

The Zone of Combat was not the only area for the employment of camouflage. The Western Electric engineers invoked its refinements in a way peculiar to themselves. The object was to preserve the utmost secrecy concerning their strange war devices. None, for example, but the engineers immediately concerned could have guessed, in running through the Engineering Department files, that the term "recording oscillograph" was a pure bit of camouflage for the "sound-ranging" apparatus later found so effective in locating enemy guns. And had German spies succeeded in breaking through the constant military guard maintained over the safe in which were locked these papers and blue prints whose secrets might have meant so much to the Kaiser, they might have spent the balance of the war in a vain effort to decipher the strange allusions and "hen tracks" with which the correspondence and drawings were "bugged."

Final assembly and testing of apparatus took place in "The Dugout," a small, airtight and artificially ventilated room, forbidden to all except the one or two engineers directly concerned with the final assembly and testing.

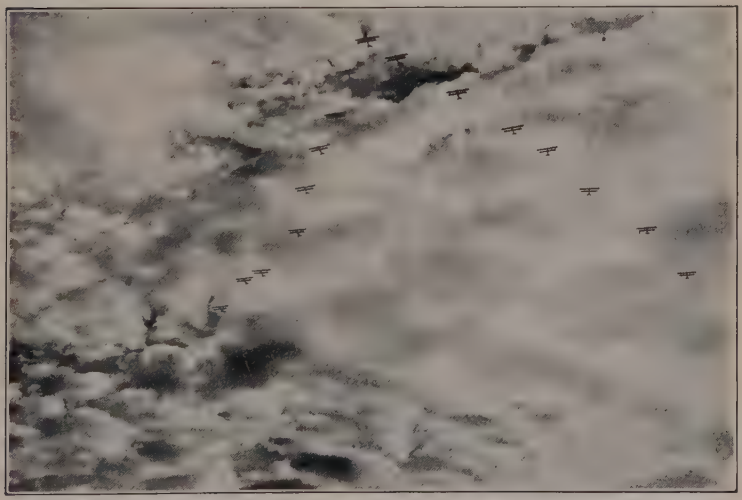
Similar secrecy was observed in the manufacturing end at Hawthorne.

But there, of course, the problem was larger, as the number necessarily engaged on this work was overwhelmingly greater. And yet there is not on record a single case of



WIND-DRIVEN GENERATOR

Designed by H. M. Stoller, of the Western Electric Company, which supplies current to the radio telephone apparatus on board the plane.



"It is a thrilling sight to see a squadron of these great man-operated birds wheel and dip in response to some mysterious command coming through the ether."



THE MAGIC WAVE OF A BLUE PRINT

Four days after the telephone man waved his blue print over this patch of wilderness, it was occupied by the Yaphank central office building.



TELEPHONE CONSTRUCTION AT CAMP MILLS, GARDEN CITY, LONG ISLAND

"leakage" from the ranks of that remarkable group of workers.

When you have stepped inside the big gates at the entrance to the Hawthorne works of the Western Electric, you find that you have come into a city within a city.

It is a city with 20,000 workers. It has a population of carpenters, blacksmiths, iron-workers, cabinet makers, painters, finishers, engineers, draftsmen, electrical engineers, plumbers, steam-fitters, wrappers, packers, machinists, inspectors, firemen, patrolmen, doctors, lawyers,—representatives, in short, of nearly every trade and profession.

And it is a city laid out on a plan according to the most modern ideas of city building.

A huge water tower in the centre of this city, from which radiate the streets, looms up into the air as if mounting guard over the other buildings. The city has a railway system all its own. In front of each of the big buildings, trains are constantly gliding back and forth: bringing in the raw materials, or carrying away the finished products. Within the gates, too, we find a gas plant, an electric plant, an independent water supply, a large, well-ventilated restaurant for the employés, a hospital, a library, and lecture rooms where college men and picked employés of the Company may take special educational courses—all these, of course, in addition to the huge factory buildings where the telephone apparatus is being turned out.

Nor is it a city of strenuous toil alone. It harbours for the recreation hours, six baseball diamonds, eight tennis courts and an athletic field of no mean proportions.

Interesting enough was this city during peace time. But when, during the war, you turned this municipal beehive

loose on a *war job,*—the problem was not so much how to speed them up, as how to hold them down.

Back in the early days of the war, the Signal Corps put in a call for 50,000 portable switchboards of a new design. They were needed in a hurry.

Under ordinary circumstances, it was a five months' job, but these were no ordinary circumstances.

The manufacturing organisation decided that, working at break-neck speed, they could get the work out in six weeks.

It *had* to be that sort of schedule, for—to mention just one difficulty—the tool-room, already crowded, would have to rush out Eleven Thousand Dollars' worth of new tools alone for the job.

Fifty-six tool-makers were assigned to the work. They went at it with a will, determined to meet the Government schedule if it were humanly possible.

Five days later, while they were "breaking their backs to make good," came an appeal from the Signal Corps to try to *better* the date of delivery. The apparatus was needed badly—and quickly.

Hawthorne's answer was to put one hundred and eighty-two tool-makers on the job at once. Sleeping and eating became secondary matters to these tool-makers until the job had been done. One of these worthies claims he slept sixty consecutive hours after the job had gone through.

"And," he remarked, a year later, "I haven't caught up on my sleep yet."

The tools finished, the job went to the manufacturing department, where "they were hungry to grab it," as the superintendent put it.

That order of 50,000 portable switchboards, complete, went

to the Government *just three weeks and one day* after the work was begun at Hawthorne.

"We put it all over Joshua," chuckled the superintendent. "We held up Father Time and took a little over four months away from him."

It would require a volume in itself to detail at length the hundreds of different types of apparatus, the countless new designs and ever-changing models, the thousands upon thousands of units of electrical equipment, rushed out with unbelievable rapidity by the Western Electric Company for the Signal Corps, the Engineering Corps, and other branches of the War Department, during an emergency when time and quantity were the essential factors of success,—electrical stethoscopes for the Medical Corps, kite-balloon and anti-aircraft telephone sets for the Air Service, buzzerphones for transmitting telegraph signals in such a way that eavesdropping was rendered very difficult or impossible, rough compact and fool-proof camp and field telephones which would work either on French magneto or American "common battery," gas mask telephone transmitters, radio telegraph sets for tanks, and numberless devices of a similar nature,—all standardised for manufacture and produced in quantities which told heavily at the front.

Some of the devices are nothing short of dramatic, both in the story of how they were created, and in the way they were applied. They leave us with the feeling—and inspiration—that nothing is impossible in this wonder-world of electrical science.

The problem involved in wireless telephony between airplanes gyrating through space, actually solved so that conversation could be clearly heard over the fearful din of the

throbbing motor; the problems of devising electrical and acoustic means for locating, under water, the exact direction and probable distance of enemy submarines; the problems involved in equipping submarine chasers and other craft with the wireless telephone; the weird electrical apparatus for recording, with eerie exactness, the position of enemy guns and of enemy airplanes engulfed in distant darkness,—these furnish a story of such exceptional interest, that they deserve to be treated more fully in subsequent chapters.

Nothing, indeed, was too absurd for the daring imagination of these engineers. No clue was too faint for them to follow. They even enlisted Rochelle salt against the Kaiser! For they discovered, by the application of what they called the "piezo electrical crystal," that Rochelle salt crystals, properly grown and treated, are efficient detectors of sound waves, converting them into electrical waves, and vice versa, that they are good emitters of tones "when corresponding electrical oscillations are imposed upon them."

And thus did the Western Electric Company earn its just accolade from a grateful Government. By virtue of a flexible, responsive, up-to-the-minute organisation of fertile-minded engineers, joined to a magnificent manufacturing establishment in such a way that the gap between *idea* and *product* was unprecedentedly short,—the organisation was able to bring to bear the full force of her splendid resources upon the military needs of the country.

It was the men and women of the organisation, of course, who earned the citation. But it was also altogether fitting that the decoration should have been bestowed upon the corporation itself; for it was solely by virtue of the *combined effort*—the superb team-work of these patriotic workers—the *soul* of the group, which was the *esprit de corps* of the

vast organisation—that the final result was made possible.

Now, every team has its Captain, who makes or breaks the team. He it is who is largely responsible for the effective co-ordination of its members. It is he that must provide the personal qualities which furnish example and incentive,—the oil of tact which ensures the absence of friction, the loyalty and consideration toward subordinates which cannot but command a similar loyalty and affection in return, and above all, the vision which spells progress and characterises the leadership of every successful institution.

In the case of the Western Electric Company, the patriotic leader was Harry Bates Thayer, who had joined the organization back in 1881, who grew with its growth, and under whose presidency it had been developed into the world's most efficient producer of the facilities of communication. When the war came, its horizon was not limited by national boundaries. Its manufacturing and merchandizing activities included the leading countries of the world. Mr. Thayer's conception of organization and of business was international. His company was ready for the war task of manufacture, just as it was always ready to rush telephone equipment to cities like Baltimore or Dayton, when stricken by fire or flood. And besides its army of workmen and specialists, it had what was equally priceless in the first hurried months when the nation was preparing to fight—a reserve of supplies.

Already the company was doing war work for the government and for the nationwide system of communication upon which so many of the government activities relied. It had already shown what it could contribute to the nation's effectiveness in war, for its part in the navy's experimental

test of military communication previously described was not a small one.

On the morning after war was declared by the United States, Mr. Thayer was early at his office and at once called up Doctor Jewett, his chief engineer. His instructions to Jewett were characteristically simple but direct. They were that the Western Electric Company laboratories and all the other facilities of the vast organization should be put, at once and unreservedly, at the disposal of the national government. Thus was an industry mobilized. As head of this organization, Mr. Thayer had anticipated the crisis. Promptly and unhurriedly and with a complete understanding of the seriousness of the situation, he gave the necessary orders so that all that the organization had should be devoted to the great cause. The gallant crew so wisely chosen and capably led, were with him to a man and knew that he would support them unreservedly. As one of his engineers said, "When war came, we all realized that our leader's patriotism was without a flaw. No crew could have asked for more freedom or better support. We never lacked for men or money or authority to go ahead. There would have been very different results if we had not had such a president as Mr. Thayer."

In the early months of the war, as has already been shown, the submarine menace seemed to be without control and the Western Electric Company was one of the first industrial organizations asked to develop methods of combating the submarine menace. The detailed story of this work is told elsewhere, but Mr. Thayer's position in this matter is of special interest. He told his engineers and other lieutenants that there was no limit to what the company would do to break down the submarine offensive, because unless this

submarine problem was solved, there could be no future for American industry or American freedom.

It was the same with the airplane wireless telephone work. He engaged his company on a tremendous program of development, manufacture, and expenditure, with very slight authorization, and with correspondingly indefinite prospects of payment. He told his staff, "Do anything necessary and give everything we have." In February, 1918, when the President asked him to become a member of the Aircraft Production Board, the government was nearly overwhelmed by the vastness of the undertaking upon which, without proper preparation and without perhaps time for deliberation, it had necessarily become involved. It was an unsought and well-warranted honor that Mr. Thayer should be selected as one of the members of the Aircraft Production Board, but the honor was not without its danger. He appreciated that he was risking his personal reputation in undertaking a task which might not be possible of successful accomplishment and where his best efforts might be of no avail. But Mr. Thayer said to one of his colleagues, "The commander-in-chief has called upon me for this service and no personal considerations should have any weight in the matter."

So it was that this great industrial organization, unrivalled in the field of military communication and national communication for military preparedness, was not found wanting in leadership or morale when the time came for its greatest effort.

CHAPTER XXII

VOICES IN THE SKIES

HAVE you ever been up in an airplane? If so, you will readily appreciate the pertinence of the following supposition.

Suppose yourself inside a power plant. Immediately before you a dynamo is roaring a terrific din into your ear. Somehow, all the winds of Aeolus have been let loose in that plant. They are rushing a constant blast across your face.

Several miles away, in a similar power plant, under conditions exactly like your own, you have a friend.

A miracle occurs. You and your friend and both power plants are suddenly lifted mile-high into the air. You find yourselves tossing about like feathers in a tempest.

You utter a prayer, coupled with a wish. If you could but talk with your friend!

And lo! a small box, about a foot cube, opens before you, revealing an assortment of glass tubes and other paraphernalia, connected to a helmet of peculiar design.

You fit this helmet about your head.

As if by magic, you find yourself in communication with your friend, conversing with him as easily as if you were both sitting tête-a-tête in your own home parlor!

And that, substantially, is the miracle that was accomplished in airplane telephony, during the brief summer and fall months following our entry into the World War.

We are already familiar with the amazing developments in wireless telephony that took place in this country before we entered the great contest.

You will doubtless recall how, when we were still neutral, Shreeve, stationed at the Eiffel Tower in Paris, heard words spoken at Arlington, thousands of miles away—the same words heard at the same time in far distant Honolulu; how, during the mobilisation test of the forces of communication which took place the following year, the Secretary of the Navy was able to talk to the Commander of the U. S. S. *New Hampshire* stationed at his bridge; and how the latter had called up his wife through the air, had conversed with the Great Lakes Naval Training Station, two thousand miles away, and with the commandant of the Mare Island Navy Yard, off on the Pacific Coast.

It will thus be seen that our country had established an astonishing groundwork in wireless telephony on a practicable basis before we ever became involved as a belligerent.

And yet here is the surprising thing.

When Shreeve was in Paris, on his Eiffel Tower mission, the subject of wireless telephony for airplanes was broached to the French military authorities. It seemed certain that the French must be interested. They had developed the airplane to such an extent, that our own few decrepit military planes had become ridiculously obsolete by comparison. The combatants were apparently missing no tricks in the line of military devices. Inventions and improvements, both German and Allied, had crowded upon one another with unbelievable rapidity in the brief three-year cycle of nerve-straining conflict.

And yet the French saw no military possibilities in airplane telephony!

They were convinced that the thing was impracticable—at least within the probable period of the war's duration.

The Chief Signal Officer of the U. S. Army, Major General Squier, was not so convinced. He had seen enough tangible evidence of American resourcefulness in electrical communication to support almost any degree of optimism. When the suggestion was made by Western Electric engineers that here was a highly important and wholly practicable field for experimentation, he was immediately interested.

And so in May, 1917, a month after we entered the war, he called a conference which deserves to be recorded as a milestone in the history of human progress.

There were present, at this conference, Colonel Rees, of the Royal British Air Force; Captain, later Colonel C. C. Culver, of General Squier's staff; Lieutenant-Colonel Frank B. Jewett and Major E. B. Craft, of the Western Electric Company.

With characteristic force, General Squier disclosed the picture in his mind's eye of the part the airplane was to play in the war, and pointed out the immense strategic value that would accrue to our air forces, if a successful means of voice communication could be established between battle planes flying in squadron formation.

The average man-on-the-street would have been forced to smile at General Squier's confident optimism as he ordered Colonel Jewett and his brother engineers, in a sober, matter-of-fact way, "to proceed with the development of a radio telephone communication system for use in aircraft."

For "he was asking them to produce," as the Assistant Secretary of War put it,[1] "what the science of Europe had

[1] America's Munitions, 1917-1918, p. 324, Report of Benedict Crowell, the Assistant Secretary of War, Director of Munitions.

been unable to create in nearly three full years of acquaintance with the successful ground system, although the needs of airplane fighting demanded this invention as they demanded almost nothing else."

In an incredibly short time our man-on-the-street would have ceased to smile.

"The first development," continues the Report of the Assistant Secretary of War,[1] "was carried on in the laboratories of the Western Electric Co., on West Street, in New York. Men and materials were drafted from every department of the company, and the laboratories were soon seething with activity. In a few weeks the first makeshift apparatus was assembled, and the first practical test of a radio phone on an airplane was made at Langley Field at Hampton, Va., less than six weeks after the Signal Corps had given the go-ahead. Three employees of the Western Electric Co. on that day established telephone communication between an airplane in flight and the ground. A few days later the first apparatus produced successful communication between planes in the air."

In my search for a first-hand story of the amazing developments that followed, I was finally directed to a quiet and simply furnished office on the top floor of 463 West Street, New York.

There I found a well-groomed, "regular fellow" sort of man—not at all the conventional kind you would look for in an engineer—with a pleasing personality and an easy, conversational manner, back of which you could detect a volume of that quality which is far more prevalent in the Court of

[1] *Ibid.*, p. 325.

St. James than in the engineering laboratories of an electrical manufacturing concern.

It was E. B. Craft, Assistant Chief Engineer of the Western Electric Company.

He started with one or two personal reminiscences, mostly humorous, and then related the details of a narrative so well put together, that it is worthy of reproduction here:

It would take volumes to describe the innumerable experiments and heartbreaking failures before the first real successes. So far as the radio part of the equipment was concerned, we had an answer in a short time. We had developed some very successful forms of vacuum tubes, and it was a simple matter to assemble them with the necessary coils, condensers and other apparatus that comprise the transmitting and receiving elements.

But working this apparatus under ordinary conditions on the ground, and in a swift-moving and tremendously noisy airplane, were two entirely different propositions. The noise of the engine and rushing air was such that it was impossible to hear one's own voice, to say nothing of the weak signals of the telephone receiver.

One of the first problems was to design a head set which would exclude these noises, and at the same time permit of the reception of the telephone talk. A form of aviator's helmet was devised with telephone receivers inserted to fit the ears of pilot or observer. Cushions and pads were provided for adjusting the receivers to the ears, and the helmet fitted close to the face so as to prevent, as far as possible, the sound being heard either through the ear passages, or through the bony structure of the head, which acts as a sort of sounding board. A helmet was finally developed and found to solve this portion of the problem. You know how sensitive the ordinary telephone transmitter is to extraneous noises, and it does not require a wide stretch of the imagination to picture how this would act alongside the exhaust of a 200 H.P. gas engine.

A brilliant line of experimentation, largely at the hands of J. P. Minton of the Transmission Laboratory, resulted in a form of telephone transmitter or microphone, which possessed the remarkable quality of being insensitive to engine and wind noises, and at the same time very responsive to the tones of the voice.

With these two elements in hand, the problem was solved—so we thought. The fact remains, however, that three solid months of the hardest kind of work was necessary to iron out all the kinks and get the thing in shape so that it might be considered a practicable device for the everyday use of other than experts.

The question of weight was of the utmost importance, and a structure which would adequately house and protect the delicate parts from the vibration and jars of flying and landing presented a difficult mechanical problem. Day and night work in the laboratory and model shop was followed by trips to the field, and many of our men soon reached the point where flying had no charms for them.

There were, however, incidents which helped to lighten the strain, some of which are still recalled with glee by the engineers who harrowed their very souls over the problem.

"I remember," said Clement, "of a laugh we once had on Oswald—or maybe the laugh was on General Foulois, of the Air Service—I'm not sure. Anyway, the General was to witness one of the demonstrations we held in October, 1917, and to direct by voice the movements of the airplane that Oswald was flying in. We had a megaphone attached to the wireless receiver at the ground station. Oswald was way off in the sky somewhere—you couldn't see him—and General Foulois had his back to the megaphone.

"All at once Oswald's voice came out of the megaphone, as clear as a bell, and as loud as a fog horn—

"Bring on your damn general!"

"The General quickly turned around, startled, and then, seeing the joke, grinned broadly. He was really too surprised to feel peeved. I hurriedly got in touch with Oswald, told him the General—undamned—had been 'brought on' in time to hear what Oswald had said, and the real show commenced."

And then came *the day.*

There is always such a day in the history of every great invention. It is the day when the stage is sufficiently set, the audience sufficiently large and select, to make the raising of the curtain a vitual début to the great wide world.

The Aircraft Production Board and the Joint Army and Navy Technical Boards were making a tour of the various airplane factories of the country. In the course of their tour, they were expected to arrive at the Moraine Flying Field, Dayton, Ohio, on December 2, 1917.

Craft and his fellow engineers, working on the airplane telephone problem, sensed the Great Opportunity.

"For it must be remembered," Craft said, continuing his narrative, "that the idea had not yet been sold to any but the wild enthusiasts who had been living with the job for the past six months.

"To those of us who were mixed up in this little affair, there will be three days which we will never forget.

"It was a great gathering. Colonel Carty and Colonel Jewett were there, and all the leading lights of the game had congregated for the event—Admirals, Generals, foreign representatives and experts galore—all willing to be shown, but all decidedly skeptical.

"Two days before the arrival of the notables, we packed up our gear in New York, and in company with Colonel Slaughter,[1] head of the Radio Division of the Signal Corps, descended upon the unsuspecting village. Our party was made up of H. W. Nichols, R. A. Heising, L. M. Clement and the writer."

The first problem was to secure a plane for a trial flight

[1] Nugent H. Slaughter was one of the Western Electric radio experts who, upon Colonel Carty's recommendation, had been commissioned in the Signal Reserve Corps early in the game, along with Jewett, Craft, Shreeve, McGrath, Buckley and the others.

and test of the equipment. It was not at all an easy matter.

"Pilots," as Craft observed, "are fussy as to what is loaded into their planes, to say nothing of the trailing wires that serve as antennæ. The designers and constructors hold much the same view, so it took a lot of manœuvring and diplomatic jockeying to get the stuff aboard and into the air."

And this is where Craft's diplomatic quality came to the fore. He had seen the commanding officer of the flying field, and was told that no planes were available. He was discouraged. It began to look as if they might not "put it across" after all.

And then he ran across Rinehart, star flier for the Dayton-Wright Company. It was late in the day and getting dark. Said Craft to Rinehart:

"Ever see a wireless telephone?"

"Nope," indifferently.

"Would you like to see one?"

"Don't mind."

"Here it is. Try this on." He handed over the head-set, and the helmet fitted snugly over the flyer's head.

"See? Not a bit of noise," purred Craft, in his most persuasive manner. "And it's just like that up in the air, too."

"The hell it is!" exploded Rinehart, incredulously.

"It certainly is," replied Craft. "I wish it weren't so late; I'd prove it to you." Those were the days before night flying had become so common.

But Rinehart was now eagerly excited: "Who said it's too late? Let's go up and try it."

Up they went.

"Hot stuff!" exclaimed the now enthusiastic pilot, as they landed. It was only the intercommunicating set that was

tested, but that was enough to lend reasonable assurance that the apparatus would work the following day. Says Craft:

The plan was to have two phones in the air at one time and for the official party to listen in at a ground station located on the top of a hill near the field. That night we all congregated in one of the rooms of the hotel, and worked out our scenario and held a rehearsal. Heising was one plane and Clement the other, and as they sailed over the chairs, bed, and other articles of hotel furniture, we gave them their orders and manœuvred them about as we hoped we would do the next day.

I must confess that I did not sleep very well that night, and I have a suspicion that some of the others had the same experience.

The next day we were out to the field bright and early, fussing around trying to keep busy until it was time for the big show.

And then the exalted ones arrived. We showed them the apparatus in the planes and told them what it was expected to do. And then we went up to our little station on the hill, where we had rigged up a loud-speaking receiver to the wireless apparatus, so that we could hear without head-sets.

I shall never forget my feelings as I walked up that little knoll that was to serve as a ground station. It was a case of make or break. The thing was either going to be a hit, or else dead forever—or at least dead so far as the present war was concerned.

The planes left the ground. There followed what seemed like an eternity.

The crowd was plainly bored. This was only one out of a large number of things they had come to see. The test of the new De Haviland plane, for one thing, occupied a far more conspicuous position in their minds. They began to fidget. So did we.

And then came the preliminary sounds in the receiver, which to us, at least, meant that they were ready to perform.

Someone made a remark, followed by a snicker.

Suddenly out of the horn of the loud-speaker came the words, "Hello, Ground Station! This is Plane No. 1 speaking. Do you get me all right?"

The bored expression immediately faded, giving way to a look of sheer amazement.

And then came a second voice. "Hello, Ground Station! This is Plane No. 2. Any orders?"

Everyone was now talking at once. It was an excited audience.

Colonel Slaughter, adjusting his head-set, took official control of the planes in the air. Under his immediate voice command, the planes climbed and volplaned, circled and side-slipped, now approaching and now fading away into the distant sky. They were sent on scouting expeditions, during the course of which one of the planes created a diversion by reporting, "I am now passing over German territory, I see a German brewery." Continuous conversation was carried on, even when the planes were out of sight, and finally, upon command, they came flying back out of space and landed as directed.

From that moment the radio telephone was sold. It was not a question after that as to whether it would work or was any good, but how soon could we start manufacture and in what quantity.

To the uninitiated it might seem that our troubles were over. As a matter of fact they were just beginning. It is one thing to construct a few experimental models by hand, and quite another proposition to start them on their way through the factory on a quantity production basis.

All sorts of mechanical details had to be worked out. The various appurtenances that go to make up a complete equipment had to be developed. The Signal Corps having placed their orders for large quantities, expected deliveries to be made within a space of time all too short even had our experimental work been completed at the time. So it was another case of day and night work for both the engineers and the manufacturing departments at Hawthorne. As soon as a detail was decided upon, it was rushed out to Hawthorne and work on the tools started. The twenty-four-hour trains between New York and Chicago were well patronised during this period.

Each modification had to be checked by tests in the field and our force of "aviator engineers" were kept busy. Not all the chances are taken on the battle line. The five engineers who did the bulk of the field testing during that period made a total of 690 airplane flights. They were in the air 484 hours. A. A. Oswald alone made 302 flights totalling 206 hours, and he is still alive. It is a truly remarkable and happy fact that during all this flying, not one serious accident was recorded. It is no use talking about the narrow escapes, for in this game also, a miss is as good as a mile.

This combination of engineering and manufacturing preparation continued well through the year, and early in 1918 we com-

menced turning out the apparatus, well ahead of the delivery of the planes in which they were to be used.

Mention has been made of the helmet and the transmitter which have proven so successful in operation. It may not be amiss to mention another detail which forms an essential part of the outfit and upon which work had not really been started until after the Dayton demonstration. You know, of course, that electric current must be applied to operate the set, this current being used to heat the filaments of the vacuum tubes and to operate the transmitter. Now the planes were already loaded down with all the gear they could carry, and the use of heavy storage batteries was out of the question. The constructors would allow nothing to be connected with their engines, so there was nothing left but to supply our own dynamo, and drive it by a wind propeller, taking its power from the rushing air.

Airplanes are in the habit of flying at various speeds, and the specifications stated this to be from forty to one hundred and sixty miles per hour, the latter figure representing the speed when the machine was diving. Our little dynamo, therefore, had to deliver a constant voltage with a speed varying from 4000 to 14,000 R.P.M. (revolutions per minute). So far as we could find out, this had not been done before on the ground, to say nothing of in the air. Fortunately, another of our West Street genii, Hugh M. Stoller, turned the trick, and by means of our new friend, the vacuum tube, our little dynamo was made to perform in the most steady-going and dependable manner.

So it went. If it wasn't one kind of trouble it was another, until everyone began to look a litle haggard and worn, and would jump when a door slammed. We consoled ourselves, however, with the fact that the people at Hawthorne were having their troubles, too, and anyway it was war and it was a sort of comfort to know that even though we were not permitted a part in the excitement and glory on the other side, we were doing something to help.

In the meantime, in October, 1917, Captain (later Colonel) C. C. Culver had been delegated to go overseas with some of the early sets of radio telephone equipment, for a demonstration of what had been accomplished to date in this new and promising field.

Culver, a Regular Army officer—one of the most brilliant

WAR DEPARTMENT,
WASHINGTON.

December 9, 1918.

My dear Mr. Vail:

The Chief Signal Officer, General Squier, has called to my attention the splendid spirit of cooperation and helpfulness which has been evinced during the war by the wonderful engineering organization of the American Telephone and Telegraph Company. The Airplane Radio Telephone Set, which has proven so satisfactory to the Air Service, and which has brought about entirely new methods of military use of airplanes, is a particular example of the result of this cooperation. The evolution and development of this and other important apparatus was made possible only because your engineering staff freely furnished the highly technical knowledge and skill necessary in the development, design and manufacture of the sets.

Please express to your engineers my appreciation of the splendid service rendered.

Very truly yours,

Secretary of War.

Mr. Theodore N. Vail, President,
American Telephone and Telegraph Company,
195 Broadway,
New York, N. Y.

HOW THE AIRPLANE RADIO IMPRESSED THE SECRETARY OF WAR

and capable officers, in fact, on General Squier's staff—had from the very first been an ardent enthusiast and believer in interplane telephony. Since 1915, he had been conducting the army development of airplane wireless telegraphy at the aviation school at San Diego, California, and was later detailed to work with Jewett and the other Western Electric Engineers on the airplane wireless telephone, bringing to their assistance the result of his experience and the point of view of the trained military man and the aviator. While not

a developer of equipment, he had rendered invaluable assistance in testing out the equipment developed, in securing the necessary field data, and in adapting the wireless telephone to the intricacies of airplane operation. His share in the struggle to put the airplane telephone on a practicable footing had been a large one.

Upon his arrival in France, he was met with universal skepticism, not only on the part of the Allied officials, but on the part of our own officers as well. "They could not believe," records the Official Report of the Assistant Secretary of War,[1] "that this country could out-distance the scientists of the Allies who had had three years of war experience to draw upon."

They were soon convinced. Demonstrations made at the flying field at Villa Coublay, near Versailles, opened their eyes to the enormous importance of something they had refused to believe worth while.

Both the British and the French began to develop experimental apparatus. Soon cablegrams were arriving from abroad requisitioning the American apparatus in large quantites—"convincing evidence," in Secretary Crowell's opinion, "that it had greater promise than any other." [2]

One immediate result of the airplane telephone was to reduce the time of training aviators to one-half, and the number of casualties to practically zero. The comparative "fool-proofness" of the airplane telephone sets, too, is nothing short of astounding. According to the records of Colonel Culver, as of May, 1919, out of a total of 8000 flights, the following cases of "trouble" developed: 175 engine and plane trouble, 75 radio trouble, of which 50 cases were due to glassware and

[1] America's Munitions, p. 327.
[2] *Idem.*, p. 328.

25 to mechanical faults in the airplane telephone set. In other words, out of 8000 flights, there were only 25 cases of airplane telephone trouble, or less than one-third of one per cent of the total.[1]

A typical drill is thus described by an eye-witness:[2]

Four army planes under the command of Capt. Lucas were sent up in squadron formation, while we, with telephone receivers at our ears, remained below to hear and see the practical application of the invention.

Capt. Lucas' plane flew above the wedge formed by the three other planes.

Presently we heard in a calm voice, which we recognised as that of Capt. Lucas, the command:

"Column right!"

"Go."

The squadron instantly responded to the new command.

"No. 2, you're out of line. Do you hear me, No. 2?"

No. 2 dipped twice in assent. The planes were so equipped that only the commander could transmit by voice, while the other planes could only receive.

"Reverse right!"

"Reverse right!"

"Go."

"That's fine; now come back where they can see us better."

The squadron had gone some distance away, but it now swung around and soon was above us again.

"Are you 2000 feet up, No. 1?"

No. 1 gave the negative sign—two horizontal dips—and rose at once to the required height.

"Two tail spins. Two tail spins. Go!"

Instantly the three planes dropped into two tail spins and as the last spin was about finished, we heard Lucas' voice calmly say:

"Come out of your tail spin, No. 2; you're too low."

The planes came out of their tail spins and received Lucas' next order. "All right now. Cut off your engines."

[1] Data as furnished by L. M. Clement, of the Western Electric Company.

[2] John T. McCutcheon, in the Houston (Tex.) *Post*, December 23, 1918.

A couple of moments later the four planes landed in exact formation and almost simultaneously, and we went over to see the wireless installation in the captain's plane.

The British made excellent use of the airplane radiophone on their night bombers. Fatal collisions, which had occurred in the landings of these midnight marauders, were easily and simply avoided when the pilots found themselves able to converse with one another in the dark spaces of the night.

And now a word or two as to how the airplane telephone works. I do not propose to give a full explanation, for two reasons—either of which is sufficient: first, I do not fully understand the apparatus myself; and second, if I did, I should probably require at least six volumes to explain it fully. As it is, I shall have to borrow heavily from the explanations of others.

Drop a pebble into a pool of water, and you form a circular wave which would widen indefinitely, were the pool of indefinite extent.

"Drop a sound," so to speak, into space, and you start a series of waves, not in two, but in three dimensions: in *all* directions.

The same applies to light, heat, electricity.

The *operating radiograph,* or what is more familiarly known as the *wireless,* consists in *generating* and *controlling* electrical vibrations of great intensity, which are thrown into space, which seem to proceed in every direction, which seem to conform to the curvature of the earth, which seem to penetrate most material substances. They spread and fill space as do the waves of sound: and, like sound waves, their intensity diminishes with distance. They are loud or intense at the source, and almost imperceptible at the receiving end.

The existence of these waves has long been known. But until Hertz discovered a practical "detector," which enabled him to set up electrical waves of definite length, and to measure them, it was impossible to convert these waves into any tangible form.

What Hertz did in the laboratory, Marconi did in the commercial field, greatly extending the length of these waves by the employment of aerials and antennæ.

Now the important thing about these waves is, that they are of different lengths, frequency and intensity, which can be *controlled,* "made to order," so to speak; in other words, which can be used for telegraphic and telephonic signalling purposes.

Thus, a continuous "wave train" may be created, which may not only be made to serve as the basis for a radio telegraph channel, but which may also be required to perform the additional burden of acting as *a carrier for voice waves.*

Voice waves may thus be "superimposed upon"—carried on the back of—electro-magnetic waves, to distances and at a rate of speed immeasurably greater than they could possibly travel by themselves,—186,000 miles per second, to be exact, or a little over seven times around the earth in one second.

Hence the wireless telephone.

Now for the wireless telephone as used in an airplane.

Electric current is supplied by the wind-driven generator to a couple of vacuum tubes mounted in a box filled with coils, condensers and the like.

But this current, which is a "direct current"—direct from the dynamo—must be transformed into a "high frequency alternating current" before it can be made to carry the voice vibrations.

That is where the vacuum tubes come in. They do the necessary transforming.

The "high frequency alternating current" is fed out in a constant stream of waves projected into space through the antenna. This antenna consists of a copper wire about 200 feet long, which, with a lead weight on the end, trails out behind the airplane when it is in flight. Normally this wire is wound up on a reel, and is let out and wound in as occasion demands.

With the special form of transmitter previously described, talk is impressed on the electrical waves set up, carried into space, and picked up by similar antennæ either on other planes, or on masts on the ground.

One more point. How did Minton prevent the terrific noise of the engine from obliterating the sound of the human voice?

That, too, is a matter of vibration.

The human voice vibrates at more than 200 waves per second. The noise of the engine, of the propeller, of an exploding shell, vibrates at less than 200 waves per second. What Minton did was to tune up the sounding and receiving apparatus so as to record only the sounds that exceed 200 vibrations per second, thus excluding all other sounds. Neither the vibration of the roaring motor nor the thunderous crash of a shell can penetrate the transmitter, which clearly catches the quiet voice of the speaker.

CHAPTER XXIII

HOSTS ASSEMBLE: CAMPS AND CANTONMENTS

WITHIN a few days after Pershing's departure on the *Baltic,* the first definite plan for the raising of the American Army was published by the Adjutant General.

The Army of the United States was to be made up of the Regular Army, the National Guard and the National Army.

The Regular Army was to be immediately increased by the addition of the four remaining increments, and raised to maximum war strength by the end of June, 1917.

The National Guard was to be called into Federal Service in three increments: the first on July 15, the second on July 25, and the third on August 5.

Sixteen divisions of National Guard were to be federalised.

Finally, the first 500,000 men of the National Army were to be called to the colours September 1, and put under immediate training in divisional cantonments.

It was a huge host. It was to be raised in record time. And—

It was to be housed in camps and cantonments a large proportion of which were still on paper.

Existing military posts would have to be tremendously enlarged. Absolutely new training sites would have to be located and built up. Entirely new cities of 30,000 to 40,000 inhabitants would have to be created over night.

Besides the 16 National Army cantonments, 30 new camps were to be erected for training purposes, some of them with a maximum capacity of between 50,000 and 60,000—robust communities of respectable urban size. There were to be camps for the training of the line, camps for heavy and light artillery, camps for Quartermaster Corps training, and for the Engineers; Ordnance camps, and camps for Signal Corps instruction; Aviation camps, including flying fields, aero training stations and aviation repair depots; temporary camps for the Regular Army, and special Officers' Training Camps,—not to mention the tremendous expansion that would have to take place of existing forts, army posts, arsenals, depots, naval training stations and the like.

It was a mad rush.

But there was momentous method in the madness. Everything depended upon the quickest possible acceleration in the speed with which we assembled our fighting forces and brought them to bear on the line.

It was therefore vital that no salient part of this programme should sag. It must go through substantially on schedule time.

And as usual, with every modern form of human effort, whether in peace or war time, the advance herald of this gigantic activity came rapping at the telephone door, in its first call for service.

Before any of these camps or cantonments could be built, arrangements must be made for telephone service.

A camp telephonically cut off from the rest of the world would not, to-day, be a camp, but a military hermitage.

Everyone who has visited the National Guard or National Army camps during those days of seething war energy when

the camps were swarming with khaki-clad men, must have been impressed with the complete, city-like life at each of these remarkable military centres. And therefore, perhaps, it did not much surprise you, when almost the first thing you saw, as you entered the headquarters office to get your pass approved, was the old familiar desk telephone—the same telephone that adorned your office back in that other world of mufti whence you came.

So accustomed are we to take things for granted, that it probably never occurred to us to wonder if anything out of the ordinary was involved in getting that telephone there. Yet there is a story of considerable interest in the way the telephone was rushed to these camps, mostly ahead of scheduled time, often even before the camp site itself had been definitely located.

For naturally, there was a great deal of uncertainty at the start. It was not till later that complete control of Army telephone arrangements was placed in Signal Corps hands.

It was a period which one telephone foreman described as "the time when we were chasing all the uniforms we saw all over the country, with a coil of duplex in one wheel-barrow, and a switchboard in another, hoping they would settle in one place long enough for us to give them some telephone service."

The government plans at times matured so slowly that the "plant men," in providing equipment, often had to go by intuition more than anything else. But whether by intuition or good luck, they usually succeeded in providing the necessary facilities well in advance of the need.

"Rumour had it," relates one local manager, "that an Embarkation Camp was to be built near Englewood, N. J. And that was really the first intimation we had that a camp was

to be started in our midst. The newspapers finally mentioned it, and then we got busy.

"Saturday morning, August 11, at ten o'clock, McArthur Bros. Co., of 120 Broadway, New York City, called the Englewood office and asked that an individual line be installed on the camp site, somewhere in Dumont, Haworth, or Cresskill. They did not know the location, but they knew they needed telephone service, and they wanted it Monday morning, August 13, although there was no building to put it in.

"The Plant Department started work Saturday noon and worked Sunday, and by Monday noon they had two circuits run and instruments mounted in soap boxes on a tree. The Plant people beat the contractor to the job and had service ready for them when they arrived."

To establish these two telephones alone, in such a way that there would be a sufficiently flexible radius within which they might be moved as emergency dictated, required 75,652 feet of wire!

It was a case, throughout, of watching every possible source of information, and "jumping to it" as soon as anything definite transpired.

"On April 19th," reported *Collier's Weekly,* in its issue of June 23, 1917,—

> the morning papers stated that the War Department would probably open a training camp on May 1st for 2500 officers at Sacketts Harbor, N. Y., on the shore of Lake Ontario. The telephone people knew what that meant to them, and went on the job at the double-quick. Their plans called for replacing the overloaded switchboard at the military post, putting in scores of telephones, booths, etc., about the camp, a half-mile of cable, and new circuits on to Watertown, Syracuse, and Utica—190 miles of wire, 130 miles of phantom circuit, and some 1200 cross-arms with the necessary insulators, etc. There was no time to order material in the usual way; it had to be found throughout the

division, and found it was at Auburn, Hamilton, Herkimer, Pulaski, Castorland and way stations. Six foremen started the big drive simultaneously; every man of their husky outfits knew his job and did it well, and they had most of the wire up by the time formal approval was received on April 27th. Bucking reels, climbing poles, tying in wire, splicing cable, nights and Sundays —it all looked alike to them. Rain was the only obstacle feared, and there wasn't enough of that to matter. The Government was not able to get its new buildings finished, so opening camp was postponed to May 14th; but on April 30th, one day ahead of the original date, the telephone people had everything O. K., and six men at Madison Barracks were operating that new board.



WHILE WAITING FOR A TRAIN

Plan from which the Camp Mills central office building was erected. Drawn upon a rough piece of paper with a lead pencil by A. C. Thomas, of the Engineering Department of the New York Telephone Company, in the railroad station at Garden City, Long Island, after inspecting the camp site.

The same sort of thing was true all over the country, north, south, east and west. I have merely selected my instances at random. Down in Little Rock, Arkansas, they are still talking of "the way those wild telephone fellows went to it at Fort Logan H. Roots in the early days of our scrap with the Kaiser." Fort Logan H. Roots, incidentally, was named after a former president of the Southwestern Bell Telephone Company, Colonel Logan H. Roots, who was in charge of supplies on Sherman's march from Atlanta to the Sea.

The problem as a whole, and the way it was handled, is briefly but comprehensively summarised by the Chief Signal Officer, in his Report to the Secretary of War, 1919:

> Prior to the outbreak of the war the Signal Corps had established, owned, and operated a complete telephone system at every Army post throughout the United States and its insular possessions with the exception of one. These systems were, in many cases, especially the larger and those lately installed, modern common battery installations with underground distribution wherever practicable.
>
> On the enlargement of the number of posts and the construction of new camps and cantonments, it was realised that it would be impracticable to procure all the necessary equipment that would be needed without outside aid; also that it would be impossible to provide the necessary personnel at these installations in the time that would be required.
>
> A conference was therefore called at which representatives of the independent, as well as the associated Bell Telephone companies were present, and it was finally agreed that it would be to the best interests of the Government, as well as the several telephone companies interested, if these installations were made by the nearest operating company.
>
> In order to provide uniformity, Mr. Waterson, Engineer of Traffic of the American Telephone & Telegraph Co., was appointed to represent the Bell Co., and Mr. F. B. McKinnon to represent the independent companies, and it was agreed that all general matters pertaining to the installations would be handled through these persons.

At this time the programme was to establish 16 National Army cantonments and 16 National Army guard camps, besides the enlargement of several posts to care for the officers' training camps, mobilisation of separate units, and base hospitals.

(It ultimately transpired, as a matter of fact, that in addition to the camps referred to by the Chief Signal Officer, dozens of other camps and scores of army posts, forts, stations and the like, had to be either constructed or expanded, and this, of course, meant a corresponding degree of activity on the part of the Signal Corps and the telephone organisations co-operating with the Signal Corps.)

The Report of the Chief Signal Officer continues:

The common battery service at Camp Lee, Va., was supplied by the Petersburg Telephone Co.; that at Camp Sherman, Ohio, by the Chillicothe Home Telephone Co.; and at Camp McArthur, Tex., magneto service was supplied by the Texas Telephone Co., these three being independent companies.

All of the remainder were cared for by the Bell companies.

"Regardless of the company providing the plant, however," comments the Chief Signal Officer further, "the lines of competing companies where they existed were connected to the camp switchboard for local and long-distance service, and all the companies showed great interest and energy in getting these connections established promptly."

As the Chief Signal Officer intimates, it was not merely a task of wiring up the camps for local military needs: these camps, every one of them, had to be connected up to the great, nation-wide network leading to and centred at Washington; and this meant that miles of new pole line had to be strung out to whatsoever sites the government determined to select, regardless of their distance from neighbouring cities or towns.

The Report continues:

The National Army cantonments being of a more permanent character, central energy systems were installed at these places, and they principally consisted of from 8 to 20 position switchboards with a maximum of about 400 telephones. The National Guard camps were to be abandoned in a short time, and therefore the installations were kept to a minimum. These were all local battery systems and consisted of from 3 to 4 position switchboards and not over 200 telephones.

Although it was the original plan for the camps, i. e. (National Army cantonments) to open on September 5, 1917, this did not develop in all cases. Telephone service proportionate to the size and demand of the camps, however, was finished on time.

Engineers of the various Bell Companies have estimated that the work they did on these camps and cantonments, including not only the installation of telephone systems at the various camps, and the laying of long distance wires to these camps, but also the manufacture of switchboards, of cable and other necessary telephone material, under normal conditions would have required nine or ten months at least.

That this all-important work was rushed through in the few brief summer months of 1917, during a time when wholesale depletions were being suffered in the ranks of telephone employees due to enlistments in war service and shifts to higher-paying war industries, speaks volumes for the efficiency of the organisations, and the untiring loyalty of the men who put their shoulders to the wheel to make the thing possible.

CHAPTER XXIV

KEEPING THE HOME WIRES HUMMING

"THERE is just as much drama *behind* the curtain," a well known playwright used to insist, "as there is in front of it."

The drama in front of the telephone curtain, during the war, was obvious. You couldn't miss it. You saw it, heard it, felt it, everywhere.

But just as the audience seldom concerns itself with aught but the play before its eyes, so during the war, we saw little else but the external show in the telephone drama often enacted before us.

Take, for example, some of the episodes at the various army camps and cantonments.

A soldier enters the Y. M. C. A. hut at Camp Funston. The 89th Division is being moved, and the boy wants to call up his home and say good-bye. After some delay—the toll circuits are overloaded—the connection is established and the farewell rendered. That is all.

That, at least, is all the outsider sees.

But here is the inside story, as told by the chief operator.

"One night, during the moving of the 89th Division, when every toll circuit was carrying more than its allotted load, a soldier boy at a Y. M. C. A. hut put in a call for his home.

"The call was delayed, and at ten o'clock at night, the operator checking delayed calls reached the boy, who had

waited all evening, and asked if he would stay there while she again tried to get his party.

"'Yes,' he said, 'I'll stay all night if you will get my mother.'

"Said the operator: 'If you will stay all night to get your mother, I'll stay all night to complete your call,' and although her trick ended at ten o'clock, and she had been through a hard, busy, nerve-racking day, she stuck, completed the call at a few minutes past two in the morning, and went home smiling contentedly through tears."

Or, take Camp Dix, in New Jersey, one of the largest camps in the United States, containing upwards of 80,000 men at one time,—a "finishing camp," where organisations were consolidated, given their last few weeks training, and finally equipped for overseas before proceeding to Hoboken or Philadelphia for embarkation. New organisations, comprised of men from practically every State in the Union, were constantly arriving: special units and entire divisions would be picked up and whisked off almost overnight. And it would seem that no sooner did an organisation get its final orders to leave, than every man in camp, from the commanding officer to the merest recruit, must call someone up for a final "good-bye." California or Maine, it made no difference, the calls would come pouring in all at once.

Before the curtain, you beheld the drama of a departing host, embracing its near and dear ones over the telephone with a final message of adieu.

Behind the curtain—who, in those days, stopped to look?

"On those occasions," writes the chief operator at this camp, "reinforcements were summoned out of bed (fortunately the girls' quarters immediately adjoined the office), marshalled in bathrobes and kimonos and marched over to

the office, where they would stay on the job till the last ticket was completed. In times such as these there would be one hour, two hours and even three hours delay on all calls.

However, we *did* make exceptions.

"I remember it was the night that the 303rd Engineers were leaving. An insistent call came in for the Chief Operator. I still had a batch of tickets in my hand when I answered the call. It was a private of the Engineers calling from a coin box in the Railway Station.

" 'I have a wife and baby in Terre Haute, Indiana,' he said. 'They tell me there is two hours delay on all calls. I am A. W. O. L. from my company right now. Can't you rush my call?'

"We got that private's call through, somehow, and as I had a head-set on, I had the pleasure of hearing his first cheery 'Hello, dear,' myself—and I won't say my eyes weren't damp."

But still further behind the scenes, in back of the switchboards, in back of the valiant, tireless operators, lay the broad organisation of men and women, depleted in number by war's requirements, upon whose shoulders fell the tremendous and ever-increasing load of "keeping the home wires humming" in spite of everything.

Without them the telephone was not.

Without the telephone—chaos unspeakable.

"How many persons did the Bell Telephone System have in the war?" one of the telephone officials was asked.

"About 200,000," he replied promptly.

"You don't say! Wasn't that a pretty large percentage of the total?"

"One hundred per cent!" was the terse reply.

And that is the meaning of Major General Squier's press-

ing appeal to these workers, when he exhorted them to stick to their posts in spite of the almost irresistible urge that drew them toward the firing line. . . . The telephone organisation at home simply *must not break* down. Its paralysis would mean the collapse of our home base. That would mean the collapse of our army in France. And that would mean—everyone knows the answer.

"You will be called upon," General Squier earnestly pointed out, "to meet demands of the most urgent kind; you have been called upon and you may be called upon further to provide men trained in the art of constructing and maintaining telephone and telegraph lines. I, therefore, direct your attention to the fact that men and women now engaged in providing this all important service can serve their country in no better way than by sticking to their posts."

It was a timely appeal.

"At the time it was issued," recounts one of the telephone executives, "it was becoming desperately difficult to hold the men of fighting age,—many of them above fighting age,—to their positions in the telephone line. They were wavering, breaking ranks and retreating to the shelter of recruiting offices in droves.

"One of the men, virtually indispensable at his post, frankly confessed on leaving: 'I know you're right about it's being more patriotic to stick where I am, but I simply haven't the nerve. I've got to go out and fight.' "

Let no one imagine for a moment, therefore, that the task of "keeping the home wires humming," swallowed up as it was in silent, glamourless obscurity—no sound of fife or beating of drum—was a whit less vital, a whit less difficult, a whit less courageous, than the task accomplished "over

there" in the full light of day, in the glitter and glory of the public spotlight.

Not that any of us would detract one jot from the honour due to the men who, "living like rats and fighting like heroes," bore the brunt of immediate contact with the foe. Much, naturally, has been written, more will be written, more should be written, about the men on the firing line. They did their work nobly. They upheld the best traditions of the American people. Their deeds were romantic and thrilling, and we glow with pride as we read of their achievements.

But it is no disparagement to these men to say that, for every man on the firing line who won his decoration, there was another back home who, in similar circumstances, would have covered himself with equal glory. There were millions of mute inglorious military heroes who never left their native shores, who were ready and anxious to go, who, if they had gone instead of those that did go, would in all probability have brought about the same net result as that achieved by their overseas brethren. And none would be so ready to admit this, as those who held the overseas portion of the grand, World-War sector.

As the winner of a Distinguished Service Cross put it, "There's so much bunk in this hero business, that I sometimes have to laugh. I don't mind telling you *I'm* damn glad the war's over."

The author, in his peregrinations about the A. E. F. following the Armistice, heard exactly the same sentiment expressed on every hand. It was epitomised in the classic utterance of the negro soldier on trial for having gone A. W. O. L.

"Will you promise never to go A. W. O. L. again?" he was asked by the trial officer.

The negro rolled his eyes for a minute in puzzled uncertainty, and finally admitted—

"Ahm not plumb shuah, boss cap'n, but ah promise, if ever ah gets outa dis yeah army, ah'll nevah go A. E. F. no moah!"

Few Americans would hesitate to do their duty when it came; but few normal Americans are anxious to step in the way of a shell, or delighted with the detonation of an air bomb.

I remember my first experience in an air raid. I do not blush to admit the presence of an icicle, for a moment or two, chasing its ticklish way up and down my vertebral column; and I verily believe that was the experience of others who saw far more hazardous service than the author.

The braggart is universally appraised at his true value. We found him in every walk of military life during the World War. It worked itself out in a species of relative contempts. If he happened to be an aviator, all who fought on the ground were "beneath him" in more senses than one. If he fought in the front line trench, he had an everlasting contempt for the man in the reserve trenches. If he was stationed in the reserve trenches, his scorn went out to the artilleryman, several kilometres to the rear. If he chanced to be with the latter organisation, he scorned the man at the divisional post of command; and if there, his contempt was visited upon the men at army headquarters. If located with the latter, he vented his scorn upon the men at General Headquarters of the Zone of Advance, and if he happened to be there, he meted out his contumely to all within the S. O. S. (Service of Supplies). If, perchance, he himself was a

member of the S. O. S., then words were inadequate to express his pitying contempt for those "who never got across"; and if he happened to be with the latter, he looked with proud disdain upon all civilians.

We all recall the story of the returning "hero," who had done his most valiant fighting in a debarkation camp at St. Nazaire, and who, immediately upon his return, took occasion to twit his neighbour for never having donned the uniform.

"Yes," was the quiet rejoinder, "I just slacked my way through the war, testing planes in flight at the Curtiss plant, to make sure some aviator didn't break his neck!"

The true feeling of the average soldier who was "lucky enough to get across," is expressed in the narrative of one of the lads—a mere boy of 19—from the Chesapeake & Potomac Telephone Company, a youngster who foolishly worried himself sick because he didn't get over.

"When I was in camp my last night I cried and slept by the side of a fellow that did get over and he said to me, 'Old pal, you didn't miss a damn thing by not getting to go across.'"

This lad was not alone in his keen disappointment. It was shared by many far older and wiser than he. In the Regular Army, especially, it was among the bitterest of sacrifices made by the officers and the men.

"I have seen strong and grizzled men of the army," said Secretary of War Baker,[1] "turn away from my desk to hide tears when they were asked to stay in this country and do organisation work here instead of going to France where the glory of their profession lay."

[1] Statement made before the Senate Committee on Military Affairs, January 28, 1918. (Official Bulletin, January 29, 1918.)

And then there were cases such as those of Major Yundt, of the Southern Bell Telephone Company, and Major Manson, of the New England Telephone & Telegraph Company. These men, having organised their respective telegraph battalions, whipped them into shape, become personally attached to them—looking forward with pride to the day when they would lead their outfits across the Atlantic and into France—were forced to stand by and see their men march off under other commanders, whilst they themselves, in response to pressing necessity for their services at home, had to stick to their posts at home like good soldiers and fight the silent battle where they were most needed.

The large majority of our overseas veterans understand and appreciate that but for these soldiers at home, their own effort would have counted for little. The situation was largely governed, not by choice, but by dominant national necessity. To each was assigned his task, according to age, sex, talent and training; and there, by the grace of common sense and the force of selective service, *they kept at it,* writing their respective pages of world history.

"Keeping at it" in the telephone and telegraph game, grew more and more of an heroic task as the war progressed. The pressure from without grew heavier, the drain from within more serious. It was a period of national activity without precedent in the country's history: and the telephone, naturally, was both expression and barometer of this activity.

As the miners of coal and iron ore redoubled their efforts to supply the flaming forges fashioning the steel sinews of war; as the railroads struggled manfully to cope with the colossal load of distribution; as the great metropolitan centres continued to precipitate an ever growing burden upon

the diminished shoulders of the telephone organisation: New York, with its throbbing commercial war activities, its vast agglomeration of munition plants, factories, shops and mills fused together into the space of a few square miles; Boston, with its contiguous arsenals and sources of military supply; Detroit, with its motor and aircraft activities; Washington, that peaceful political village of yesterday, mushroomed to almost unbelievable size and super-strenuous activity within the space of a few months; Philadelphia, Chicago, San Francisco, Seattle, and the rest, with their shipbuilding, ordnance, shell loading, rifle manufacturing and million-and-one other war activities,—expanding, expanding, ever expanding, with the available telephone workers ever diminishing—is it any wonder that dire prophets of the time predicted an early collapse for the telephone organisation? And is it not one of the amazing feats of the war that these heroic workers, under the fearful handicaps imposed upon them, saw the thing through?

CHAPTER XXV

NUMBER, PLEASE, A. E. F.!

It was one of those start-stop trains, *en route* to Bordeaux. Just now it was in the stop stage, having run twenty consecutive minutes. The stop was designated on the station sign as *Libourne*. It was a long, long stop. Four restless doughboys trudged through the corridor of the train. They passed a compartment containing five representatives of the fair sex. They paused and looked in uncertainly.

"Combien kilos a Bordeaux, s'il vous plait?" one of the doughboys inquired.

"I'm sure I don't know," was the weary response. "I only wish I did!"

Four doughboys staggered back in unison. Four doughboys rubbed their eyes and stared.

In a dazed sort of way, they asked, "Are—are you Americans?"

"You can bet your tin hat we are!" was the answer and that, of course, settled it.

No English girl—of whom the doughboys had seen a goodly number in France—could talk like that. She might imitate the "American accent" (as the English have it), but it would never occur to her to suggest the wager of a tin hat.

But how did these girls get here? What were they doing in this war-torn land, thousands of miles away from home and safety and comfort?

Who were these trim figures in smart, blue uniforms, with blue aviator-caps, and white brassards on their left sleeves?

The doughboys soon found out.

They had come face to face with sisters of that personage back home whom they had known only as a Voice. They beheld Central in the flesh.

One of the pluckiest groups of Americans had come to help them win the fight for democracy.

American girls!

In the truest sense of the term, they were a sight for sore eyes.

"Where are you from in the States? How long have you been here? How do you like France? Where are you stationed? What do those insignia mean? You're the first American girls we've seen or talked to in the last eight months."

Precisely as ever, they answered the breathless inquiries.

"I'm from New York. Miss ——— is from Minnesota. Misses ——— and ——— are from California. Miss ——— is from Massachusetts. We've been here ten days. Fine—so far. At Bordeaux, where we're bound for now. Telephone transmitter embroidered in black, means junior operator; laurel wreath beneath transmitter, supervisor; both, surmounted by a streak of lightning, chief operator. We're mighty glad to see you, too. And we're mighty hungry."

That was enough for the boys. They became, on the instant, Big Brothers, by natural right. They had been gassed, these boys, and were on their way to the hospital at Bordeaux. But what of it? What was a little thing like that to this new-born, undeniably pleasing sensation of responsibility?

They foraged around until they found some hard rolls in one of the stations, they filled their canteens with water, they salvaged a cake of chocolate minus a generous half-portion that had been gnawed away—and the resultant meal was flavoured with what many a sumptuous banquet has lacked.

One of the foreign words heard a great deal during the war was *morale*. It has since been naturalised and given the full rights of American citizenship. It was a word the meaning of which was fully understood by General Pershing and his staff. And it may have been that something of its meaning was in their minds when they called for the creation of a Telephone Operating Unit to serve overseas as part of the Signal Corps.

But whether intentional or not, the connection between these girls and the *morale* of the American army was certainly there. For proof, I cite one of the stories sent home by a war correspondent. War correspondents are supposed to be the most blasé personages in the world.

The sweetest, most homelike sound I have heard since leaving the States was the voice of a telephone girl.

This is said in the most impersonal way, as I never saw the lady.

It seems to be my fate to have the blues during my first three days in each big city. That was certainly my unhappy lot in Paris.

The third day, business prompted that I call up Mr. Sharp, the U. S. Ambassador.

Not being hep to the French language, the hotel interpreter was requisitioned. He wrote down some figures and told me to make certain noises that sounded something like passy douze cinkante. I tried my best to gargle that into the phone, but evidently didn't say the right thing because there was a female gasp at the other end. Then I tried harder and louder than before. This was answered by an uncontrollable giggle.

"Whom do you really want?" came back in perfect English. "Possibly I can help you."

It took me a full minute to recover.

"I want the American Ambassador—God bless you!"

"Oh, his number is 1250," the same being spoken in my own language better than I can speak it myself.

With my abalone-like ear wrapped around that receiver and listening for all I was worth for that voice, I could have imagined myself in a certain well-known office at First and Broadway.

It broke up the blues. I wanted to give three cheers for something or other. I breathed a silent prayer that all the hello girls in the world might prosper and marry well.

I reckon that the well-modulated, courteous and very American accents of a hello girl dripping in at the left ear have much the same effect on a homesick American as the soothing hand of a nurse on a sick soldier.[1]

But *morale* was not the reason officially assigned for the creation of this remarkable addition to the Signal Corps family.

"The use of female telephone operators in France," according to the official Report of the Chief Signal Officer,[2] "was decided upon for two reasons. The first of these was the unquestioned superiority of women as telephone switchboard operators——"

For if it is true that the hand which rocks the cradle rules the world, it is also true that the soft answer which turneth away wrath—the voice with the smile—is exceedingly effective in expediting the all-important telephone connections under the stress of combat, when tempers are apt to ruffle and cuss words to impede the channels of swift intercourse.

"——and the second (i. e. reason) was the desire to release for service in the more dangerous telephone centrals at the front the male operators on duty in the larger offices."

[1] This is the story, substantially, of Harry A. Williams, published in the Los Angeles (Cal.) *Times* of May 14, 1918.

[2] Report of the Chief Signal Officer to the Secretary of War, 1919. Government Printing Office.

(It was not then contemplated to use women operators for switchboard duty at the front. That came later, when these game girl soldiers, filled with the spirit of service in the great cause, eager to go—volunteering on every available occasion to go—to the forward areas, had their share in plugging away by candlelight in the subterranean depths of an army exchange.)

A veritable tidal wave of excitement swept across every telephone switchboard, from Maine to California, when General Pershing's cable of November 8, 1917, calling for the creation of a Woman's Telephone Operating Unit, was announced from Washington.

The overseas trumpet calling to the women of the land! What a chance for the adventure-loving American girl! Thousands of feminine breasts beat violently, thousands of pulses quickened, in answer to the summons. The first call, to be exact, was answered by 7600 applications.

But two huge impediments loomed up at the very outset as grim eliminators in the sharp contest evoked by this call from the other side.

First, General Pershing's requirements were ruthlessly limited on the first call to an even one hundred: "3 chief operators at $125 a month, 9 supervising operators at $72 a month, 24 long-distance operators at $60 a month, 54 operators at $60 a month, 10 substitute operators at $50 per month, total 100."

It was to be a select band indeed!

But that wasn't all. These girls must be able to understand and speak French as well as English.

For the great majority of trained operators, this requirement was a knock-out blow.

"To think," bemoaned one of the operators, "that I didn't take French in school, as my mother wanted me to, but instead—of all things—German!"

"Never mind, dearie," was the consoling advice of her friend, "your chance will come when the boys get to Berlin."

But Pershing's bilingual stipulation was not an idle one, as the girls were ultimately to realise. For they were to serve, in very truth, less as operators than as interpreters by telephone—often on the most vital matters—where a mistake might mean irreparable loss. At St. Mihiel, for example, the Army had to handle an immense amount of telephone communication with the French armies on its right and left, with French corps in the army, with the French group of armies, and finally with General Headquarters. Similar conditions applied throughout the A. E. F. during the early months. It was not until the later phases, when the greater part of telephone service in the A. E. F. came to be transacted between American offices, that this requirement of familiarity with the French language was relaxed, in favour of long distance operating experience.

And so it was essential that the first 100 girls selected from the thousands that applied, should know and speak French virtually as well as their own native tongue. But they must also be qualified, to an exceptional degree, as switchboard operators. That naturally threw the job of securing, examining, selecting and training these girls, upon the shoulders of the telephone organisations.

At the request of the Signal Corps, the Engineering Department of the American Telephone and Telegraph Company, with the assistance of the operating companies of the country, undertook to secure the necessary operators, and to

turn them over to the Signal Corps properly trained, organised in groups and equipped to start for France.

A canvass of the telephone forces soon revealed that a sufficient number of French-speaking operators were not available inside the organisation. A considerable number therefore would have to be obtained from the outside.

The process of selection began.

Miss de Blank, say, of Minnesota, is one of those that has applied, along with thousands of others. Her turn for examination finally comes. She presents herself at the offices of the Northwestern Bell Group.

With beating heart, she is led to an inner sanctum, containing a single table, with a telephone on it and a chair.

"Be seated, please." The attendant disappears, and she is alone.

The bell tinkles. Somewhat uncertainly, without having been instructed to do so, she answers the telephone.

"Hello," comes a strange voice into the receiver. "This is the Adjutant, ——th Division, located at ————, in France. The Commanding Officer, General Jones, wants to talk to Colonel La Roux of the ——th Brigade, ——th French Army Corps, located at ————. General Jones understands no French, and Colonel La Roux understands no English. It will be necessary for you to translate General Jones' message into French, and Colonel La Roux's reply into English. Ready? Hello, this is General Jones now speaking——"

"General Jones," having delivered his message, is suddenly transformed into "Colonel La Roux," and receives the translated message. Whereupon the supposed French Colonel gives his reply in French, and, in the rôle of General Jones, gets his reply in the desired English.



INSIDE VIEW OF CENTRAL OFFICE AT CAMP LOGAN, HOUSTON, TEXAS



TELEPHONE OPERATORS OF THE BELL TELEPHONE COMPANY OF PENNSYLVANIA, AT CAMP DIX, NEW JERSEY



Photo by Morris Rosenfeld

FIRST TELEPHONE OPERATING UNIT TO GO OVERSEAS

View taken on the roof of 195 Broadway, New York City, with the bronze Herald of the Spoken Word, which annihilates space, overlooking the scene.



U. S. Official

TELEPHONE OPERATORS AT BARRACKS 66, TOURS, FRANCE, APRIL 19, 1918

The test is carried on through a long and complicated conversation; careful notes are taken throughout as to any errors or confusion on the part of the candidate in the handling of the message; with the result that out of ninety-three candidates (selected after a preliminary weeding-out) who presented themselves for examination in the area of the Northwestern Bell Group, *five* are chosen to go on to New York for final approval!

Next comes training, especially for those who are new to the telephone game.

No phase of training throughout the entire military gamut is conducted on a more intensive basis than this. It is not merely training by the telephone companies: the operators themselves—even those not assigned to such duty—deem it their own personal affair to turn out during their spare time and help in the process of instruction. For it is *their* war, as much as anyone else's.

Seven training centres are established: At New York City, Chicago, San Francisco, Philadelphia, Jersey City, Atlantic City, and Lancaster, Pa.

Naturally, amusing incidents occur in the course of training, incidents particularly amusing to those familiar with the technique of the telephone exchange.

"The enthusiasm of these girls," writes one of the supervisors in charge of instruction, "was something to warm your heart. Sometimes it took an amusing turn. In one instance, a girl had been impressed with the fact that all line signals should be answered quickly and should not be allowed to hang. One afternoon when the signals were not coming in fast enough to suit her on her own position, she observed a

signal burning two positions away. Quickly she jumped up out of her seat and reached her cord way over the heads of the operators adjacent, plugged in, and hurried back to her seat to complete the call."

Or this, culled from one of the quiz papers which the girls were obliged to answer at regular intervals:

Question: "What is the difference between a common battery board and a magneto board?"
Answer: "A magneto board has shutters which drop down; the operator has to put them up. A common battery board has lights which the operator puts out with her plug."

One day, one of the girls on the toll or long-distance board was handling a "collect call" on what is known as the "two-ticket method" to New York.

"Pass me your ticket" called the New York operator, as per formula; meaning, of course, that she repeat the data on the ticket.

The poor girl was floored, but only for an instant. Quick as a flash a brilliant idea struck her. Swiftly and determinedly she rolled up the ticket, and was jamming it into the "jack" when discovered by the supervisor.

"Next thing you know," remarked a visiting supervisor, when told of this episode, "she'll be trying to send General Pershing a pair of socks by wireless. I suppose they're pretty green."

"Yes," replied the supervisor in charge, "but they're a mighty *bright* green—without the slightest trace of yellow."

She was right. A pluckier lot of girls were never banded together.

"Out of 60 girls who were inoculated," reported the Official Bulletin,[1] "not one fainted. An officer who has seen many soldiers meet the same experience said this was most unusual."

The girls were to give further evidence of their pluck before very long.

The unit sailed in three groups. The first, in charge of Chief Operator Grace D. Banker, a graduate of Barnard College, Columbia University, and a former instructress in the operating department of the American Telephone and Telegraph Company, set sail on March 2, to be followed by the second contingent on March 16 and the third in the latter part of April.

The A. E. F. soon became aware of a new presence in France. But as usual, it was all on the "audience" side of the curtain. What transpired behind the curtain was, naturally, of little concern to the rest of the A. E. F. And yet it was by no means devoid of interest. I shall let one of the girls tell her own story:

The first unit of telephone girls, numbering thirty-three, of which I was a member, arrived in Paris March 24, 1918, about 9:30 p. m., after a rather eventful journey. An army officer who had boarded the train several hours out of Paris told us that shells fell in Paris every ten minutes. All the lights on the train were camouflaged and so were all the street lights on our arrival at the station.

Weary and tired after a nine-hour ride on a French train we had to walk about twelve blocks with all our hand baggage to the Hotel Petrograd, at that time the Headquarters of the Y. M. C. A.

Shortage of fuel made it impossible to have a warm bath, so we cheerfully took cold sponge baths and retired as soon as pos-

[1] May 21, 1918, p. 13.

sible. At 2 a.m. all the siren whistles in the city sounded and we were madly rushed to the cellar, as that meant an air raid by the Boches. For the first time, we heard the deafening sounds of exploding shells and barrage fire. Most of us were too tired to care much and as the cellar had been comfortably fixed, some slept. At seven the next morning we had breakfast. French breakfast, consisting of coffee, bread and jam.

Another "lady" joined us in Paris that day—Big Bertha. She created considerable conjecture, for no one imagined it was a long-distance gun. Everyone looked up in the clouds for the invading Gotha. But before long, they found out who it was that was making all the racket. They did create some confusion, though, and made some very interesting "rooins," but we didn't mind them nearly as much, I'm sure, as the Germans would have wished. (Later, we worked out a schedule for Bertha. For several days on end, she would visit us punctually every fifteen minutes. Places were struck all around us, but fortunately neither our office, which was then the Élyseé Palace Hotel, nor our house, which was the Hotel Ferras, was touched. It was about a fifteen-minute walk from the Élyseé Palace Hotel to the Hotel Ferras. At lunch time, the operators would wait for a report from the big gun, and would hurry home as fast as they could, arriving there just ahead of Bertha's next greeting.)

Our first day in Paris, the girls were all assigned to different offices; eleven to Chaumont, twelve to Tours and ten to Paris. I was assigned to Paree.

The next morning we were ordered up at 5:30 a. m. and after taking the other girls to their trains, Lieutenant Hart, in charge of the Paris telephone office, took us to the Hotel Mediterranee, at that time the American headquarters in Paris.

We were told to get ready to start work at once. The Telephone Exchange was being operated by English-speaking French girls, with an American sergeant acting as chief operator, information and all-around factotum.[1]

They had a seven-position board, with hardly any designation strips, and no regular directory. The French girls whom we replaced had been in the office since its infancy, so they knew all the numbers, and did not feel the necessity of having a direc-

[1] This was Sergeant Jennings, of Kansas City, who had been detached from the 412th (Southwestern Bell) Telegraph Battalion, to open the Paris telephone exchange, using, at first, French girls during the day and American soldiers at night.

tory. They resented our coming, as it put them out of good jobs, and all but two left that morning. This made it doubly difficult for us. As no one called by number, Sergeant Jennings had to stand behind the operators, and give out the numbers impromptu upon demand.

Poor chap! he had an awful job on his hands.

Before long we had a directory made up, a more efficient arrangement of the boards had been effected, and we began to have a little system. Later on things ran as smooth as clock work.

Oftentimes, during the early days, after saying "number please," there would be a silence, broken by an awed, "Oh!" Sometimes it would be, "Thank heaven, you're here at last!" One man called for the American Ambassador and added, "God bless you!"

At the time we began there were four American exchanges in Paris: our own headquarters, the Air Service headquarters on Avenue Montaigne, the Research and Inspection Division on the Boulevard Montparnasse, and the American Provost Marshal on the Rue St. Anne. All these were still operated by French girls, and to say that they were difficult to deal with, would be to put it mildly.

Most of our toll calls, in fact, had to go over the French lines, and that sometimes made things very trying.

When you wished to call over the French line, you said, "J'ecoute" (I listen).

After a quarter of an hour, the conversation would begin.

"Good morning, how are you? Are you tired? If you please, I should like to get——"

All this had to be in honeyed tones, otherwise there wasn't the slightest chance of getting any attention.

And mademoiselle would reply, "Ah oui," in a languid sort of way, as if the call were of no particular moment, but might as well be handled, now that she was about it.

If you asked for one place too often you committed a serious blunder, for the result would be something like this: "You are unbearable, you ring too much, it gets on my nerves. *Je coupe!* (I disconnect) and—bing! the line would be lost and that was an end to that.

But sometimes our own nerves got pretty well on edge, too.

There was a certain line which, though numberless, was known as Colonel Hall's line. Where it was, or who Colonel Hall was,

no one knew. All we did know was that Colonel Hall was very hard to deal with, touchy and exacting. To make it worse, he was always calling some obscure town which had to be reached through the French Central.

One day it had been unusually busy. Miss Naismith was supervising. She was also doing information work, and from answering the numerous questions which were being fired at her from all sides, her head was in a whirl.

In the midst of this chaos, Colonel Hall's line signalled, and he demanded the supervisor.

"I must have my call for——at once!" he demanded.

A little impatiently, he was assured he would get his party as soon as the call could be negotiated through the French Central.

"Now I know I'm difficult, supervisor," came from the other end of the line, "but my calls are vital. I'm a medical officer with two wards of wounded men who should be operated on. I cannot do it until I receive some ether. There is not a bit of it anywhere around here. I must get it from the place I am calling."

"Colonel Hall, I'm ashamed," was the humble response. "Anything that is in my power, I shall do for you. I shall call you shortly."

Immediately she called the supervisor in the French office and told her that an American *General* wished a connection through to —— at once.

Nothing less than a general's rank could make an impression on the French operating force. Colonel Hall probably does not know to this day that he was thus temporarily promoted. All he does know is that he got his call through very shortly after he had put it in, and Miss Naismith went to bed that night praying that the ether arrived in time.

And so it went. War was war, we simply had to make good, and so we did our best.

Of the operators assigned to other places in the A. E. F.; of those who came later (there were 233 in all who crossed, in six operating units, besides hundreds of others under training at the time of the Armistice); of the superb spirit displayed by these girls at crucial stages of the conflict, and the invaluable service rendered at the front during the major

engagements,—more will be told in later instalments of the main narrative.

Let us return, now, to the general telephone and telegraph situation in France, as developed by the A. E. F. Signal Corps up to this time.

CHAPTER XXVI

THE NET EXPANDS

By the time the brave little feminine army of operators had begun to bear down upon the A. E. F. with their cheery but business-like "number, please," the American network of electrical communication in France had expanded to considerable dimensions.

But it was still far from its goal, as might be evidenced by the fact that a large proportion of it still consisted of leased circuits.

These so-called "leased lines" (they were not really leased, but loaned), while gratefully appreciated by the Chief Signal Officer of the A. E. F., were by no means "a thing of beauty and a joy forever" to his maintenance and repair men.

Had you chanced upon Jim Blaine and Frank Nelson, from the Pacific Bell Battalion, during one of their line-testing expeditions, you would have appreciated to the full the double difficulty of testing on lines which were not only of foreign construction, but which sent forth a stream of strange foreign words the moment you tapped in on them for a test.

Behold, then, Jim Blaine at the top of a pole, looking for a circuit in trouble in a maze of foreign wire.

To each ring he receives the same response "Qui est là?" (Who is there?)

Circuit after circuit yields the same result, until all the ten have been tried out.

Jim "slides down the stick" and scratches his head dubiously.

"We must be on the wrong lead, Frank. All these circuits go to Keela—wherever that is."

But Frank knows better.

"Trouble with you is, Jim," he remarks, with no effort to patronise, "you ain't learned the French language. That was 'Qui-la' you heard, meaning, 'Who're you?' Let *me* try 'er."

With an easy air of assurance, Frank mounts the pole and starts to demonstrate.

"Qu'est-ce C'est circuit?" he demands, confidently.

Pause.

"Qu'est-ce C'est circuit!" a little louder.

Another pause.

"Qu'est-ce C'est circuit, you ————————, can't you understand your own language!"

Indignant, flushed to the roots of his blond hair, he descends via the same route travelled by his companion before him.

"They're the most ignorant lot of people I ever had anything to do with!" he exclaims, with emotion.

"Trouble with you is, Frank," responds Jim, not without a gleam in his eye, "you ain't learned the French language."

Somewhat more successful in coping with the French lines, was the captain of Company D of the 409th Battalion, from the Central Bell Group. Only in this case it was the telegraph and not the telephone.

"In France," relates this officer, "the Telegraph and Postal offices are combined. The service is not of the best,

and the regulations are sometimes, like Bret Harte's heathen Chinee, peculiar.

"At one point I had occasion to do considerable telegraphing from a French office. The manager refused point blank to send anything without an official pass. I had none. I was up against it. Those wires had to get off. What to do?

"Absently, I put my hand in my pocket, when suddenly it came in contact with something that flashed an idea into my head.

"It was my laundry stamp. I pulled it out.

"'All right,' I said to the manager, 'here it is,' and stamped the messages.

"With many bows and apologies, the manager dispatched the messages forthwith!"

Detractors to the contrary notwithstanding, be it said to the everlasting credit of the French Government and people that they "came across" liberally, in the early days when "coming across" counted for so much; and this, despite their own pressing need.

But be it also said, in all fairness, that a far greater net utilisation of lines resulted from the loan of these circuits to the American Signal Corps, than they had ever known before; because we no sooner acquired these lines, than we applied to them all the latest refinements of "compositing," "simplexing," "duplexing" and "multiplexing,"—thereby making many messages grow where but one grew before.

"We saw at a glance," said one of the American wire experts, "that the French were having a terrible time handling their wire traffic, so congested were their lines. And yet a hasty survey showed us that there was no insufficiency of line wires. What impressed us was that the French had line wires enough to run along for years without new construc-

tion if they only knew how to get a maximum utilisation out of their lines. Their trouble, in other words, was not physical, but human—or, rather, organisational, for their engineers are clever. What I mean is, their system was wrong. They allowed their wire business to be run by the post office—which was a case of the tail wagging the dog.

"So we felt less compunction than we otherwise would have felt, in borrowing as many of their lines as we could. We put those lines to work as they had never been put to work before."

However, the American Signal Corps also proceeded apace with the construction of their own lines.

The two original telegraph battalions, the 406th from Pennsylvania and the 407th from New York, now had other battalions to keep them company.

The 409th, made up of men from the Central Bell Group, had arrived in the latter part of October, 1917; and shortly thereafter they began their overseas career by "pitching in" on a thirty-wire line from Tours to Autun, a distance of 70 miles. The 408th, from the Northwestern Bell Group, arriving somewhat over a month later, was assigned to building a section of the "lead" (to adopt the "patter" of the profession) from Tours to General Headquarters at Chaumont, beginning at the east end of the Loire River bridge at Nevers, and extending to a point just a bit west of Vierzon. The 412th, from the Southwestern Bell Group, coming upon the scene in the latter part of February, 1918, was promptly put to stringing two copper circuits from Dijon to Nevers. The 411th, from the Pacific Bell, arriving in France about the middle of March, 1918, was assigned to building the St. Nazaire-Nantes section of the standard ten-wire copper line running across France and constituting the

backbone of the American network; and the 401st, or New England Bell Battalion, arriving a week later, was assigned to another section of the same trans-France line.

Things had improved since the first two battalions had arrived back in August, 1917. These later battalions, therefore, did not have quite the same conditions to cope with as their pioneer predecessors. And yet they had their share of trials and tribulations.

For although, as we have seen, there had been some improvement in the supply situation, all was not yet rosy, by any means. As late as March, 1918, the 411th or Pacific Battalion began work on the ten-wire lead from St. Nazaire to Nantes "with scarcely a bar," as Major Moore, battalion commander, put it, "and barely two and one half shovels; and we finished that job with 12 shovels and 12 ordinary bars, part of which equipment we had to borrow from the French."

Not only did these battalions have to borrow equipment, but they were shorn of a very important part of their equipment immediately upon their arrival in France.

More than one battalion supply officer had chuckled inwardly as he congratulated himself upon having secured full motor equipment for his battalion before sailing overseas.

"In that respect, at least," he reflected, "we shall be ready to handle any construction job that comes along."

But alas! They had figured without the caprice of military fortune.

No sooner had they landed at the port of debarkation, than they were obliged to turn in their motor equipment for redistribution in accordance with the "modified basis of overseas supply."

It was a case of "To him who hath shall be given"—turned the other way around.

Due to a shortage in motor transportation in France, it became necessary during the early days to pool all transportation arriving and to redistribute it throughout the branches of the army as required.

"As required" meant but one thing to these battalions; a diminution in their supply of motor vehicles. And it always remained a sore spot with them.

"Look!" exclaimed one of the battalion chauffeurs to the horseshoer, as he gazed intently at an approaching Cadillac bearing on its windshield the emblem of the brigadier,—white star on red background.

The chauffeur had recognised his old vehicular pet doing duty under a new allegiance.

"Recognise that?" he demanded.

But the horseshoer evidently misunderstood.

"Sure," he replied. "That star means the old boy has a son in the army!"

Despite the handicaps, however, the Signal Corps had accomplished much between September, 1917, and March, 1918.

It is remarkable how closely the evolution of A. E. F. telephone and telegraph lines runs parallel, in its different stages, to the evolution of our overseas army and the entire A. E. F. activity.

These stages in the evolution of the A. E. F. network may be set forth as follows:

1st, Primitive: Pershing, Russel and the balance of his staff arrive in Paris in June, 1917. Immediate bread-and-butter requirements are attended to by the installation of French switchboards at Pershing's newly established Gen-

eral Headquarters in Paris, at Russel's Signal Corps headquarters, and at the headquarters of newly arriving units of the American army,—the general base of supplies at Nevers, the medical base of supplies at Cosne, the base hospital at Dijon, the headquarters of the 15th Engineers at Vierzon, and of the First Division at Gondrecourt. The Signal Corps opens a telegraph office in Paris, another in Nevers, still another in Gondrecourt, and by leased lines, communication is established between Pershing's headquarters, his general supply base, and the headquarters of the First Division. Pershing moves his headquarters to Chaumont, and a detachment from the newly arrived 406th Battalion installs an American telephone exchange, smuggled over on the *Baltic,* at the new headquarters. The newly arrived 406th and 407th Telegraph Battalions build a standard American line from Dijon to Chaumont and Chaumont to Neufchâteau, a line is also built from Neufchâteau to Gondrecourt, and thus the first segment of the projected 400-mile line is put on the French map.

2nd, Formative: The original 400-mile project is recast by Howk on a more scientific and efficient basis of wire operation. Fay and his detail of telegraph experts arrive, and the telegraph branch of the Signal Corps begins to shape up. Clarke, a "repeater" and long-lines expert, arrives and adds his specialised training to the rapidly developing long-distance telephone situation.

3rd, Augmentative: The "augmented long lines programme" (as it was generally referred to at the time in Signal Corps circles) begins to take shape. The newly arriving telegraph battalions hasten the programme for an all-American system of wire communication. Expansion is rapid. A division is made for administrative purposes, between Lines

of Communication and the Zone of Combat; headquarters of the former in Paris, of the latter at Chaumont. This takes us up to March 19, 1918, on which day the Services of Supply (S. O. S.) was formed, with headquarters at Tours, superseding the Lines of Communication. A week later the first unit of women telephone operators arrives, and introduces a new element of efficiency into A. E. F. telephone operation.

4th, Organisational: With the establishment of S. O. S. headquarters at Tours, a new and more definitely functional Signal Corps organisation emerges, and the administration of telephones and telegraphs takes more coherent shape than hitherto, based on standard commercial telephone and telegraph practice in America. The Telephone and Telegraph Division is organised, first under Colonel C. S. Wallace, then under Lieutenant-Colonel A. H. Griswold, arriving overseas as commanding officer of the 411th or Pacific Bell Telegraph Battalion. A comprehensive organisation is built up on the American, Bell-System basis.

It is to the third stage that we refer more particularly in this chapter.

The recasting of the original 400-mile line project by no means precluded the plan for a standard telephone-telegraph line leading across France from the base port at St. Nazaire to the American front; and work on this was carried forward with all the speed and efficiency of which the trained American battalions, acting under adverse conditions, were capable.

By January 1, 1918, the telephone plant of the Signal Corps in operation consisted of about 17 offices: London, Southampton, Le Havre, Paris, Brest, St. Nazaire, La Pal-

lice, Bordeaux, Tours, Nevers, La Courtine, Dijon, Valdahon, Is sur Tille, Langres, Chaumont, and Neufchâteau. These were connected for the greater part by but one or two long-distance circuits, making a total of 33 circuits. By the end of February, 1918, seven more long distance circuits had been added, and the following offices: Montoir, Saumur, Pauillac, Bassens, Blois, Noyers, Issoudun and Gievres.

The most important circuit addition during this period was the completion on March 30, 1918, of the ten-wire "lead" from Dijon to Tours, which, when extended a month or two later to St. Nazaire, completed the original design for a line from base port to the American front.

In the meantime, telegraph expansion kept pace with the telephone. No telegraph lines, as such, were being built,[1] since the American system provided for joint telephone-telegraph use of wires in such a way that the very wires over which you talked were being used at the same time for a dozen simultaneous telegraph messages.[2] New telegraph offices began to multiply in all parts of France, the largest of which, covering 24 operating positions, was installed at Barracks 66, Tours, in the latter part of March, 1918.

France, however, was not the only part of the A. E. F. covered by telegraph. On November 26, 1917, a direct telegraph channel, established by the Signal Corps from Chaumont, General Headquarters of the A. E. F., to London, by means of a circuit leased from the British, was formally opened by General Pershing; and on February 24, 1918, communication was established between the Signal

[1] Excepting those for railroad dispatching purposes.

[2] This refers, of course, to the maximum later applied in the A.E.F. by means of the triple-duplex-multiplex, whereby 6 messages, 3 each way, were sent simultaneously over each separate wire.



A BUSY HOUR AT TOURS CENTRAL OFFICE

Chief Operator Marion Swan watching work of her operating force.



U. S. Official

ART AND SCIENCE

Terminal and operating room, Elysee Palace Hotel, Paris, France, May 6, 1918. The telephone installation men of the U. S. Signal Corps were cautioned to "do the job artistically."



U. S. Official

OPERATING ROOM AT TOUL, FRANCE

Telephone girls operating the exchange at Second Army Headquarters, Toul, France. Note the portable army switchboard, resembling an army locker, in the background.



OPERATING ROOM AT GENERAL HEADQUARTERS, CHAUMONT, FRANCE

Corps telegraph office at Le Havre, and London, by means of a "four-conductor" cable owned and operated by the U. S. Signal Corps, crossing the Channel from Cuckmere, on the British side, to Cap d'Antifer and Le Havre on the French side.

And of course access was had to the existing British as well as the French network in France. One had to be something of a linguist, too, in conducting parley over the British circuits. For British-English and American-English are too different tongues when the technique of telephony is involved.

"Can you imagine a grounded line," asks Sergeant Black, of the 401st (New England) Telegraph Battalion, "being 'earthy on one leg,' or a solid ground being a 'full earth'? To say that a circuit is open or shorted means nothing at the English testboard, but if you tell them it is 'disc'd' or 'looped,' you will get their 'Right-O, old chappie' at once.

"I was sitting in on the switchboard one evening, and had put in a distant call for an American officer, when his connection was broken before he had finished. He rang and got the distant operator, who happened to be a Tommy.

" 'You cut me off from Col. ————,' said the officer.

" 'You're through,' said the Tommy, meaning the connection was re-established.

" 'I am like hell, I just started!' was the response.

" 'My Gawd, wot langwidge!' came in a distant and outraged murmur from the other end of the line."

Thus the great telephone-telegraph network was expanding throughout the A. E. F. with amazing rapidity.

It was not expanding by accident. There was design—carefully planned and carefully executed design—in back of

it; from the Signal Corps at home, through such men as Squier, Saltzman, Carty, Curtis and Coles, to the Signal Corps in the A. E. F., through the superb generalship of Russel, and the splendid quality of his organisation, rank and file, supplied to him from the American side of the water.

The unique way in which these specialists were marshalled together from the four corners of our continent, sent over in a steady stream to the Chief Signal Officer of the A. E. F., and by him utilised to the highest advantage, are matters a brief survey of which will not be idle.

CHAPTER XXVII

THE PEG AND THE HOLE

NOTHING so hugely amuses the buck private as an officer in the act of "pulling a bone."

There is the story, for example, of Captain X, of the First American Headquarters in France, as told by one of the telephone installers.

"Captain X, connected up to a magneto board, had called for help in a hurry. He was excited about something. I thought maybe all the headquarters trunks had gone out, or his P. B. X. had been hit by a bomb.

"When I got there he said, 'Look here, we can hardly hear our telephones ring. I want you to install new batteries at once, so that the bells will ring louder!' "

Captain X was in evidence throughout the war; and yet I venture to say that he was the exception rather than the rule.

Many a new command was evolved in the throes of the world conflict. But the greatest single command of them all was this: "Every man at his own game—march!"

And of all our military branches, the Signal Corps, I believe, furnishes the most striking illustration of the efficacy that lay in that command.

On the basis of the psychological tests accepted by the Army, the Report of the Chief Signal Officer shows that the

intelligence tests of the Signal Corps personnel rated higher than those of any other branch of the Army.

This was no more accidental than the final accomplishment of the Signal Corps overseas was accidental, or the presence of Squier as Chief Signal Officer of the U. S. Army, or the selection, as Chief Signal Officer of the A. E. F., of Edgar Russel—one of the few, if not the only one, of General Pershing's original staff who retained the same post throughout the duration of the war.

The great programme of advance mobilisation of Signal Corps personnel may fitly be termed the Drama of The Peg and the Hole.

The plot consisted in foiling the villainous process which inevitably takes place when you attempt to organise at the last moment: a wholesale and futile fitting of square pegs into round holes and round pegs into square ones.

Of this play, General Squier may be considered as both dramatist and producer. To him we owe it in no small part that the drama avoided a denouément of tragic tinge. Saltzman and Carty may be viewed as the leading actors in marshalling the reserve, and the thousands of trained personnel assembled by them from the Bell System and other commercial wire organisations, provide the balance of the *dramatis personæ*.

There is a prologue and five acts. There is also a sequel. The sequel makes better reading than either the prologue or the five acts; but the latter are by no means less important.

First, the prologue.

A process of sifting and selecting had taken place long before the World War was thought of (outside the Kaiser's kingdom). Had the Bell System, for example, selected at

random its personnel for construction crews, linemen, maintenance and repair men, future foremen, superintendents and the higher executives,—the entire organisation would have fallen apart like a rope of sand.

I recall the sage comment of Tony the Bootblack, whose ministrations during the past twenty years, literally at the feet of Bell System headquarters, have brought him more completely into contact with the rank and file of this organisation than any single one of its members.

"Mr. Thayer," he remarked, between slaps of the paste, "he smarta da man. Mr. Kingsbury, he smarta da man too; and Mr. Bethell, and Mr. Carty—day all smarta da men. You know why—huh? Because Mr. Vail—*he smarta da man!*"

It was not, however, merely a specially selected personnel: it was also a specially trained personnel. Linemen, for example, are put through a vigorous course of apprenticeship, so that when they are finally ready to "carry on," they hold what amounts to a diploma from the most exacting institution of its kind, with a standard curriculum and laboratory for which there is no parallel the world over.

Department heads and sub-heads are so thoroughly trained to organised effort, that the first thing they would do if thrown on a desert island would be to organise—naturally and instinctively organise.

So much for the prologue.

Act *I* we already know, having covered in an earlier chapter the steps taken by Squier and Carty in connection with the establishment of the Signal Reserve Corps and the Bell Telegraph Battalions.

Act *II* takes us to France, where Russel's pioneer organisation at headquarters is largely made up by drawing upon

the early Bell Battalion overseas—a practice which, before long, threatened to "suck these units dangerously dry," as one battalion adjutant put it in a metaphor slightly mixed, "unless they quit robbing Peter to pay Paul."

Act *III* develops the specially picked group of experts from the Western Electric organisation, carefully selected by Carty and Jewett to provide General Russel with a Research and Inspection Division whose scientific calibre, ingenuity and completeness of laboratory equipment soon won fame not only throughout the A. E. F., but at the various headquarters of the Allies as well. It is in this Act, too, that Fay, Clarke and their hand-picked telegraph and telephone experts arrive upon the scene.

By the time the curtain rises on Act *IV,* the selective service law is in full operation, and the men of the National Army are at the various camps and cantonments scattered throughout the United States. Russel, having exhausted his personnel resources in France by reaching the safety-limit of detail from Signal Corps units already there, turns again to America and cables a request for about 500 officers and men, a large portion of whom are to consist of the necessary supervising force, long-distance telephone engineers, testboard men, telegraph and telephone repeater experts, special equipment installation experts, and multiplex telegraph mechanicians and attendants.

The list is based upon a scientific estimate previously made up by Carty and forwarded to Russel, forecasting, in the light of Carty's experience as Chief Engineer of the American Telephone and Telegraph Company, the probable requirements in personnel necessary to anticipate the impending growth of the A. E. F. network.

And then begins the painstaking and red-taped process of

combing the camps of America for trained personnel drafted from Bell and similar organisations and now assigned to a variety of non-technical pursuits, from "manicuring mules" to "punching the keyboard."

Every effort is made to procure this personnel. It is laborious effort. It is, indeed, one of the harrowing episodes in the drama of The Peg and the Hole.

Carty, at New York headquarters, had lists prepared from the records of the Bell System, which told exactly where every one of its drafted men had gone, exactly what branch of service he had gone into, exactly what he could do better than anything else.

At Signal Corps headquarters in Washington, Saltzman, Curtis and Coles laboured diligently to secure the transfers of the vitally needed men called for by Russel and designated by Carty upon the basis of his detailed and carefully drawn list.

The obstacles placed in the way of these transfers have already been touched upon in a pervious chapter. One request for a transfer went through eighteen military indorsements, only to be finally refused.

However, by dint of a generous list of alternative eligibles, the needed quota was finally secured, and in due course found their way overseas, to join hands with Russel's select little band engaged in the upbuilding of the A. E. F. network.

Act *V* opens with the vanishing point in the background. The available supply of telephone and telegraph experts is well-nigh exhausted.

"In some quarters," observes the Chief Signal Officer,[1] "the opinion prevailed that this source of personnel was

[1] Annual Report, War Department, fiscal year ending June 30, 1919, p. 65.

unlimited and that a sufficiently experienced personnel existed in the United States to furnish the necessary supply of telegraph and telephone operators, switchboard repair men, multiplex and radio operators, cable men, linemen, etc., to complete the establishment of such Signal Corps units as would be required in the operation of the Army overseas. This view did not take into consideration the great change that resulted in the business world when our Republic with its pacific ideas became engaged in war. The rapid and complete readjustment of plans, of personnel, of manufacturing plants, and of products to be manufactured, which was necessary to fit them with the new conditions, greatly increased rather than decreased the normal traffic over the telephone and telegraph systems of this country; in fact the business handled by some of these companies increased manyfold. This, of course, brought about the need for additional personnel on the part of the telegraph and telephone companies which continued to be more and more acute, as the selective-service law acted to draw many competent men from their employ."

Well, then, if no more trained personnel was to be had, the obvious thing to do was to make more, i. e., to *train* them.

And this is what the Signal Corps set about to do. Schools for intensive training in telephony, telegraphy and radio were set up at different universities in various parts of the country, and by dint of constant co-operation with the commercial telegraph and telephone organisations, both in the matter of practical instruction and the loan of necessary apparatus and facilities, graduates soon emerged with a surprising grasp of their newly acquired art.

And now for a few episodes by way of sequel to the drama of The Peg and the Hole.

I have gathered these instances at random, rather than with a view to making them truly representative.

A Bell maintenance man from Pittsburg relates:

On one occasion I was directed to report to Nantes, France, under direct orders from the Chief Signal Officer, for the purpose of installing six telegraph composites and nine composite Ringer Sets. Assurance was given that all material, tools and specifications had been shipped and I should experience little difficulty in completing the job in a few days. I set out for Nantes with a smile of satisfaction, under the delusion that the army had at last bestowed upon me an easy task with which I was going to have a little spare time for enjoyment.

Upon my arrival at the Signal Office at Nantes I found one box of material, consisting of retardation coils, cords, relays, solder and several spools of wire, all scattered in a humpty-dumpty fashion in a box that was twice as large as it should have been. Imagine me with one pair of diagonal pliers and one screw driver in my pocket; expected to complete this installation at once with that box of junk.

The first thing necessary was some kind of a rack in which to mount the equipment. But where was I to get the material? Wood in France was as scarce as hens' teeth. After inquiring in a dozen different places for lumber I finally persuaded one Frenchman (with the aid of three francs) to let me have an old store box, out of which I made a satisfactory rack.

There were no specifications of any kind on the job, so it was necessary to make a schematic drawing in order to do the wiring.

The next question that presented itself was how was I to mount the relays without any mounting plate? The answer was, Make one, of course. To do this I took a thin board from my three-franc store box and punched it full of small holes to accommodate the relay terminals.

After several days of study and hard work I completed the installation, which, in all probability, would not pass a Western Electric inspection. However, it worked O. K. and we won the war; so what is the difference?

And then there was the case of a former Kansas telephone manager who, as a captain of infantry, "put one over" on

the Chief Signal Officer of the A. E. F. by "beating his men to it" and installing a complete telephone office, alone and unaided by the Signal Corps, in the sizeable town of Blois—famous alike for its mediæval dungeon, and a Reclassification Board suspended as a sword of Damocles over the heads of incompetent officers in the A. E. F.

This was one of the officers whose transfer to Signal Corps duty back in the States had been successfully blocked by the potent barrier of red tape. And yet, as we shall see, the Signal Corps ultimately acquired his services.

I was in charge of an Officers' School at Blois. We were without a telephone exchange and felt lost. All our messages went by orderlies.

One day, in March, 1918, the Commanding Officer called me to his office.

"Weren't you a telephone man back in the States?" he asked.

"I was, sir," I replied.

"Aren't you still?"

"I am, sir."

"Then why can't we borrow some French equipment and install some sort of temporary service?"

"I'll see what can be done, sir," and I got busy.

I found that some equipment had been ordered from Blois and was at Tours. In a few days I had part of the equipment on the ground. And then I got word that a special Signal Corps detail was to do all the work, as it was strictly a matter for the Signal Corps to handle. They had a considerable waiting list, and were expected to reach our town in a few weeks.

I had no idea how long a "few weeks" might be. I was afraid it might be French time. I sought out the C. O. once more.

"Sir," I said, explaining the situation to him, "if you will give me the authority to go ahead, I will install that office with what men I can pick up around the Post."

He looked at me hard for a moment.

"Can you do it?" he demanded.

"Certainly I can do it," I answered. I felt a little peeved at a question like that.

"Then to hell with the authority—go to it."

I went to it. I spent all morning poring over qualification cards. By lunch time I had located my men: seven Bell men and one marine to install the Central office equipment, and a miscellaneous group for the outside work, including a sprinkling of men from different Bell Companies.

I am sorry I have forgotten the names of these men, but there was an artillery lieutenant from the New York Telephone Company, and, besides the marine, there were five privates from various Bell Companies; an Oklahoma man from the Pioneer Company, an Ohio man from the Central Union, a Tennessee man from the Cumberland Company, a Montana man from the Mountain States Group, a California man from the Pacific Company, and myself from the Southwestern.

We got to work after lunch. We had nothing but twisted pair, but lots of that. Six men started on the switchboard. Two trucks started for Tours, 40 kilometres away, for material. Another detail went to stringing wire, still another to installing instruments.

At 4:30 p. m. the switchboard was installed, and we began cutting in the instruments. I waited until we had nine or ten telephones working, and then sent one down to the C. O.'s office.

"What's this?" he asked the installer.

"Your telephone, sir," was the answer.

"Hmm-m."

He was a bit surprised. He hadn't expected we would be able to start for several days.

But he had a bigger jolt waiting for him. His telephone bell began to ring. I was calling.

"Where are you talking from?" he demanded.

"The office," I told him.

"What office?"

"The Telephone Office."

"The wh-what! W-well, w-when do you expect to get some more telephones working?"

"About a dozen are working now," I replied.

"By God, Oliverson," he exclaimed, "if you're telling the truth, I'm your friend for life! I'm coming right up."

After supper we went to work again, and kept at it till daylight. The next morning we had everything hooked up in the immediate neighbourhood, and, by means of borrowed French circuits, we hooked up some of the officers in the town besides.

In about two weeks, sure enough, the Signal Corps detail got around to us to install our plant. They were certainly a sur-

prised crew when they saw it all in. The officer in charge called Tours for advice. They advised him to move on to the next point. Before long a Major from Tours came over to inspect our installation. When he had finished he put his hand on my shoulder and said, "Captain, you're wasting time. How would you like to transfer?"

I did not object, and that is how I happened to drift from the Infantry into the Signal Corps.

What was true of the telephone, was equally true of the telegraph. We have already seen how Fay and his experts constructed workable duplexes (apparatus for sending telegraph messages both ways simultaneously over the same wire) out of haphazard electrical equipment picked up in Paris shops, and performed similar prodigies of mechanical resourcefulness.

"In fact," observes the Chief Signal Officer of the U. S. Army,[1]

many of the American soldier-operators, by their usual dextrous application of empty tobacco cans, rubber bands, etc., were quite at home, as well as successful in their efforts to keep the allied sets lined up.

And Major Frank H. Fay, in commenting on this, adds:

Of course we depended to a great extent upon the Signal Corps back home, but a three-thousand mile gap with a corresponding length of time intervened, and we had to fill up that gap somehow. By a thousand makeshifts, impossible but for the highly trained character of the men, we managed to get things going and keep them going.

The Signal Corps in Washington, I believe, did everything they could do to help us. I know their one anxiety was to know how best to help us. But I often wondered, in those days, whether they fully realised what a tremendous problem the Signal Corps of the A. E. F. had to solve for themselves.

[1] Annual Report, War Department, fiscal year ending June 30, 1919, p. 185.

We did all kinds of things we wouldn't have dared to do, ordinarily. In compositing telephone circuits, for example, for telegraph use, a special "retardation coil" is necessary. The supply of these coils, as soon as they arrived in France, was exhausted. We had to get a new supply at once; the composites were urgently needed; new traffic, induced by the rapidly swelling American Army, was pounding loudly and insistently upon our door. It would not do to wait for the next consignment from the States.

An unheard-of experiment was tried—and it succeeded. The apparatus making up a composite, which includes two of these special retardation coils, was simply halved, and presto! we had two composites for every one the States had sent us. Since my return to the States, I have been informed on several occasions that this was impossible. It *was* impossible. But we did it. We had to do it.

However, not all the ingenuity of Carty's army of experts was lavished on telephony and telegraphy. List to the tale of William C. Elmore, Captain of Company D, 409th (Central Bell Group) Telegraph Battalion:

Nothing is more unsatisfying than to have a unique honour thrust upon you without knowing about it at the time. It places you in the position of Mike McCarthy, who complained that he didn't enjoy being sober, and he never enjoyed being drunk until he was sober again.

There is a connection between Mike McCarthy's experience, and one I had in France. A unique honour was conferred upon me, and I didn't know about it until it was all over. It happened this way:

The British electrical experts had about perfected a submarine-detecting device. There was one weak point, however, a sort of missing link.

In some way they learned I knew something about electricity. My assistance was sought. I worked up a device, and the results were evidently satisfactory, for the device was pronounced a success.

I was promptly requested to prepare for a trip to London. A British army officer, as garrulous as a graven image, was sent to chaperone me.

We boarded a destroyer, and in due time were landed at Plymouth, where we entered the coach of a waiting train, which whisked us into London almost before we knew it.

Here the B. A. O., with a promptness that nearly took my breath away, escorted me to a large chamber, in which were seated an assemblage of distinguished looking gentlemen, one of whom, evidently the chairman, requested me to state my theory regarding the device. This I did as briefly as possible.

I was then requested to visit a certain electrical establishment and select what I needed. In company with the B. A. O. I proceeded thither, and the selection was soon made. When I suggested marking the material as we would at the warehouse, so that it wouldn't get mixed and go to X-sur-God-knows-where, he cryptically remarked, "I scarcely think that will be necessary."

We returned to the train, and were whirled back to Plymouth, where we found the destroyer idly swinging at her hawsers as if awaiting us.

We went aboard, promptly headed toward the French coast, and were soon back on French soil.

The whole thing moved with such dreamlike celerity and mathematical precision, that I couldn't but remark about it to the B. A. O., whereupon he casually replied:

"Oh, yes, it was rather quick." And then he unbent a little: "Of course you didn't know it, but it was the business of that destroyer to transport you to Plymouth and take you back, and also the business of that special train to carry you to London and back to Plymouth."

I was doing my best to give a good imitation of nonchalance, when he added:

"And, by the way, those gentlemen whom you addressed were the very last word in electrical invention. The chairman is president of the foremost electrical institution in England."

By the spring of 1918, the process of fitting the peg to the hole had so progressed in the A. E. F. Signal Corps, as to permit a reorganisation which was to meet and weather the crucial storm immediately ahead.

Let us hastily review the situation as it stood just before the storm broke.

CHAPTER XXVIII

THE NET IS SPREAD

The day America accepted the Kaiser's challenge, all France was aflame with wild enthusiasm, inspired by a new-born hope. A new Ally of a hundred million souls! A country with millions of fresh fighting men! Surely, the next month or two would witness the accession of at least one million new soldiers to the Allied cause, ready to fight on the soil of France.

Such was the simple, childlike faith of a nation that had endured as almost no other nation had ever endured before.

Spring gave way to Summer, Summer to Fall, and the expected millions failed to materialise. The French were considerably perplexed, not to say keenly disappointed. What was the matter? Why didn't the millions arrive?

To be sure, boatload after boatload of pioneer staff personnel did arrive, together with a liberal accompaniment of motor vehicles, and one or two sturdy divisions; but the general feeling of disappointment was voiced by the French officer who petulantly exclaimed, "America seems to be largely a nation of experts and automobiles!"

The French simply failed to understand the American way of doing things.

They could not foresee that the time was coming when such ports as Brest, Havre, St. Nazaire and Bordeaux, fully equipped on the American scale, would resound with the

tramp, tramp, tramp of 10,000 American soldiers daily leaving camp on their way to the front, to make way for an equal number of troops freshly arrived from the other side of the water. They could not imagine that uninterrupted procession which later became so familiar—a procession vividly described by one of the newspaper correspondents: "The streets of one of these French ports invaded by the Americans ring night and day with the clatter and trundle of camions and the marching of thousands upon thousands of Americans seeking shelter in temporary barracks, to be later flung out in waves across the French provinces, covering the country everywhere with their khaki, their enthusiasm and their energies. 'In the morning,' said a French officer, 'the Americans will get a concession to build a telegraph line; in the afternoon there is a hole; by night there is a pole; the next morning there is a wire; and by night there is a message.' And when one walks into the central system at one of our large American camps in France and sees an army of American boys in khaki clicking away at telegraph instruments, or a score of American girls plugging the switchboards and calling the familiar 'hello, hello' of Broadway over independent American wires, he realises that there is little of exaggeration in this statement."

"And the Americans—are more of them still coming?" an elderly French lady once asked the author.

"Yes, more are still coming."

She mused a moment.

"Well," she concluded, "the more they come, the crazier and more wonderful they are!"

I thought I detected a note of genuine admiration in the remark. More than that, I believe it was a paradoxical

compliment representative of the French attitude as a whole.

The "crazy" construction methods, for example, of American telephone crews. They were a never-failing source of wonderment to the French engineers.

"While acting as interpreter," writes a sergeant of the 411th (Pacific Bell) telegraph Battalion,

I had occasion to explain to a group of electrical engineers of the French Postal and Telegraph System the construction of about twenty miles of toll line by the 411th Telegraph Battalion. I have never seen a more interested or inquisitive party of men. Every few minutes they would shake their heads at what they regarded as a new marvel of efficiency in line construction.

At one end of this particular line, holes were being dug in the more or less soft ground by means of the Johnson bar and scoop shovel; at other points, a number of holes had to be blown with dynamite. As we approached the group where dynamiting was going on, the party halted for a moment to see several effective charges blown, and suddenly one of them pointed rather excitedly to what struck him as a remarkable innovation. The electric current was simply being supplied from a Nash Quad truck.

The next step was the erecting of poles. These were being raised with cross-arms and insulators already in place. The French party thought that was unusual, too.

We came next to the 10-reel truck paying out wire immediately behind another truck, with an arrangement that had "efficiency" written all over it. This contrivance, built on the idea of a long arm with pins spaced to the width of a 10-pin cross-arm, and working on a see-saw plan, dipped down first on one side of a pole, picked up all 10 strands of wire, moved along to the next pole, and by means of the see-saw effect, set them down again with perfect precision on the cross-arm, where a waiting lineman steered them into proper place. I didn't blame the French for marvelling at that. It was a new one on me. It was the idea, I believe, of Lieutenant A. B. Coates, of the Pacific Telephone and Telegraph Company, at Portland, Oregon.

But what chiefly impressed these French engineers, was our method of pulling 10 wires at one time by auto truck. "One wire

at a time," remarked one of the French inspectors, "is all we ever attempt."

It was the same way in telegraphy. The French had never taken to the liberal use of "sounders," but continued to content themselves with the old-fashioned method of transcribing the message from a dot-and-dash tape, instead of "clicking them off" by ear on the typewriter, American fashion.

"And many's the time," records the official historian of the 406th (Pennsylvania Bell) Battalion, "our men would sneak out and repair French lines connected to our circuits, instead of reporting the trouble to the French authorities." The French would leave a wire out five hours, before they would consider it as line trouble.

On December 11, 1917, an entire section of the Chaumont-Neufchâteau lead was broken down by three derailed freight cars falling over the line on the railroad bridge just west of Neufchâteau. The trouble was reported to D Company of the 406th Battalion, at 6:59 P. M. At 8:30 P. M., one hour and a half later, service was re-established.

On the following morning, Hubbell, now at Signal Corps Headquarters, mentioned the incident to General Russel. "At 8:30," concluded Hubbell, "the service was restored."

"You mean 8:30 this morning," said the General.

"No sir," said Hubbell, "I mean 8:30 last night."

"Hubbell," said the General, with enthusiasm, "I want you to sit right down and tell those boys what I think of them. Make it strong!"

Hubbell tarried not in conveying the official message to his former organisation. "It was one of the pleasantest tasks I ever had," said Hubbell. "It was like being ordered to decorate my own son."

In these few instances, which might be multiplied into the thousands, we find the reason why the A. E. F. Signal Corps was enabled in the space of nine months to spread a wire network across the face of France—north, east, south, west—which reached from base ports to supply centres, thence to the manifold headquarters of the ever-increasing A. E. F. units, and from there on through the forward areas of the Zone of Combat to the very firing line; projecting itself, at the same time, beyond the shores of France and across the Channel to England, where every American cantonment was brought into immediate contact with the Commander-in-Chief of the A. E. F.

It was the American genius for short-cuts that made this possible in time to anticipate the last desperate drive of the Prussian hosts.

But it was more than a mere matter of mechanical ingenuity. It was a task that called for the highest quality of administrative generalship. It was, in fact, primarily a problem of organisation. Without that, no amount of mechanical ingenuity would have availed.

Not that the organisation was perfect from the very start. Far from it. Like every healthy organisation, it was an evolution.

From June, 1917, when Pershing first established his headquarters in Paris, to October of that year, all telegraph and telephone operations in the A. E. F. were directed from the office of the Chief Signal Officer by Paddock, Repp and Glaspey, assisted, later, by C. B. Johnson, detailed from the 407th (New York Bell) Telegraph Battalion.

These men constituted, in themselves, the whole Signal Corps telephone and telegraph executive staff: engineering

department, outside plant, inside plant,—design, construction, maintenance and repair,—all rolled into one.

No such thing as an "Engineering Division" was officially created until October, 1917. Even then it was not purely an engineering organisation; because it not merely "engineered" (i. e., designed, etc.) all telephone and telegraph projects in the A. E. F., but also directly controlled the construction, installation, operation and maintenance of all lines in the "Advance Section"—as it was then called—of the A. E. F. This control was exercised direct from Chaumont by Hubbell, who was put in charge of the newly created Engineering Division, having been detailed from his Telegraph Battalion (the 406th) for this purpose.

The "Lines of Communication," as the area back of the "Advance Section" of the A. E. F. was then known, took care of its own construction and maintenance, under Colonel Charles S. Wallace, who was made Chief of Lines of Communication; and shortly took over its own engineering as well, with Repp in charge, reporting to Wallace. Repp's "inside engineering" was handled by Fay, for the telegraph, and Clarke, for the telephone; and his "outside engineering"—which was really engineering and "plant" combined —was handled by Paul J. Ramsey, formerly Captain of Company D, 412th (Southwestern Bell) Telegraph Battalion.

Ramsey, incidentally, who had been ordered overseas ahead of his battalion, is a man concerning whose work on this particular task of outside engineering, everyone whom the author has consulted has invariably asserted: "He certainly did a 'swell' job!"

In January, 1918, Repp was transferred to Chaumont, where he relieved Hubbell as head of engineering for the

"Advance Section." Ramsey took Repp's place in charge of engineering for the Lines of Communication, under Wallace, and Hubbell was returned to his battalion, to be promoted ultimately to Lieutenant-Colonel and ordered to Washington, where imporant work awaited him at Signal Corps headquarters. Ramsey's organisation was augmented at about this time by Captain R. H. Keller of the New England Telephone and Telegraph Company (son of Jasper N. Keller, formerly president of that company), Lieutenant G. S. Lowden of the New York Telephone Company, and Captain C. O. Bickelhaupt of the American Telephone and Telegraph Company.

And this was the somewhat tentative organisation, affecting telephones and telegraphs, as it stood at the time Pershing put through his general A. E. F. re-organisation in March, 1918, just immediately preceding the final German drive.

By this general reorganisation, whose object was a sharper crystallisation along functional and staff lines, two administrative areas were established: the Zone of Advance ("Z of A"), with headquarters at Chaumont, and the Services of Supply ("S. O. S.") with headquarters at Tours.

The Chief Signal Officer was placed under Major-General Harbord, who was made Commanding Officer of the S. O. S., and Russel's able assistant, Colonel (later Brigadier General) George S. Gibbs was made Chief Signal Officer of the Zone of Advance, and Assistant Chief Signal Officer of the A. E. F.

The time had come, in other words, for a permanent telephone and telegraph organisation, ready for "real business."

The first nine months had been devoted chiefly to building up the basic network. This fundamental pioneer work

was now well under way, and the Signal Corps was ready to get down to direct military operations.

What Russel did, in brief, in working out the details of his telephone-telegraph organisation, was to copy as closely as possible the standard organisation evolved from years of experience back in the States. In doing this, he naturally consulted Carty, who wrote on February 16, 1918: "I have studied the matter carefully and it is certain that you will need some long distance personnel over and above the force that was sent with Lieutenant Fay, and over and above the relatively small number of long distance men to be found in your Telegraph Battalion which were recruited from the telephone companies. These battalions, it so happens, came principally from the local companies and contained practically none of the long distance personnel. It is absolutely essential for the success of your long lines system that a special long lines personnel be provided. I have, therefore, made arrangements to get on the track of all these long distance men who are liable to draft. Most of them are in the American Telephone and Telegraph Company, but a number of them will come from the Western Union and possibly from the Postal Telegraph Company."

The result was an addition to Russel's staff of such competent "long-lines" engineers as O. B. Jacobs, J. D. Pollock, John C. Beall, H. H. Bliss, Jr., D. H. Woodward, C. T. Blanck, W. M. Marsters, and last, but not least, A. H. Griswold.

Griswold was head of the 411th (Pacific Bell) Battalion. Colonel Allison, of the Regular Army, who had trained this battalion at Monterey, California, was enthusiastic in his praise of the men and their commander. Besides that, Gris-

wold had been Engineer of Plant for the whole Pacific Coast, had had long lines experience,—was, in short, just the man to head the A. E. F. long lines telephone and telegraph division which Russel was planning to create.

It was just at this time, too, that Griswold and his battalion were about to embark overseas.

By the time Griswold arrived in France, the A. E. F. reorganisation described had taken place. The Lines of Communication, as such, had ceased to exist, being merged into the Services of Supply, and the Engineering Division of the Lines of Communication, which had operated from Chaumont, was absorbed by the Engineering Division of the Services of Supply, operating from Tours.

The function of this new and broader Engineering Division was to "make surveys, prepare plans and charts, and have *technical* control of telephone and telegraph construction and installation in the Zone of the Services of Supply"; also to "advise and assist on construction and installation in the Zone of Advance."

Repp was put in charge of this newly organised Engineering Division, and remained in charge until shortly before the Armistice.

At the same time, the Telephone and Telegraph Division of the Signal Corps was organised, charged with the actual construction, operation and maintenance of all telephone and telegraph lines in the A. E. F., excepting, of course, those in the Zone of Advance, which were to be administered under the Chief Signal Officer of the Zone of Advance by the tactical signal units assigned to the front. Colonel Charles S. Wallace, who had been head of the Lines of Communication, was made Director of the Telephone and Telegraph Division. Some time after, Griswold arrived over-

seas with his telegraph battalion, was detached from his organisation, and subsequently relieved Colonel Wallace as Director of the Telephone and Telegraph Division, Wallace returning to the States in response to a demand that an experienced field officer be sent to Washington on staff duty to represent the A. E. F. Signal Corps.

Griswold took charge of the organisation and remained in charge until the Armistice. It was Griswold who built up and established on a solid foundation this new and vital administrative structure. It was he who laid out those carefully planned details of scientific telephone-telegraph administration upon which so much depended, and under which that magnificent development took place which was to provide an immediate and effective response to every demand made upon it in the succeeding difficult months.

From the first blueprint to the last cross-arm or extension station, the wire system grew into a machine that for precision and despatch has never been excelled anywhere, any time.

It was, in very truth, the *American system itself,* transplanted to French soil.

Strictly speaking, it was not just a single network that Russel spread across the A. E. F., but rather four separate and distinct networks.

There was, first, the Net for the General Command, Administration and Services of Supply, centring about Tours, Headquarters of the Services of Supply. This included standard American pole and wire lines stretching from General Headquarters at Chaumont to the Headquarters of the Services of Supply at Tours, to the training areas in the vicinity of Chaumont, and (later) to the Headquarters of the First Army at Souilly and the Second Army at Toul.

There was another American-built line from Tours to Chaumont via Paris, and additional standard American lines connecting Tours with the base ports at Brest, St. Nazaire and Bordeaux. Connection between Tours and the other Base Sections in France, was established by means of American-operated lines leased from the French; and the trans-channel lines from Chaumont to London, we have already noted.

Secondly, there was the Net for Command, Administration and Supply in the Combat Zone, extending from the Army Command at General Headquarters, Chaumont, to the Command and Administration centres throughout the Armies, on to the most advanced posts on the fighting front. Naturally this net was constructed, operated and maintained, for the most part, under the most trying conditions. How the work was, theoretically, distributed among Telegraph Battalions and Field Signal Battalions, has already been described in a previous chapter. How it was actually carried on, is yet to be told.

Then there was the Special Net for the Transportation Service, embracing special telephone and telegraph lines equipped by the Signal Corps and turned over to the Director-General of Transportation, A. E. F., for use in moving A. E. F. personnel and freight over French Railroads. These lines extended from the Headquarters of the Services of Supply at Tours, to the principal base ports, and up to the rail heads in the Combat Zone. Special Signal Corps personnel was detailed to the operation and maintenance of these lines.

Finally, there was the Net for the U. S. Navy in France, provided by the Signal Corps between London and the Navy Stations along the French coast. This net was made possible by the use of existing French lines, where they

could be secured by lease, and throughout the other sections by the construction of standard American lines. From Le Havre, on the north coast of France, to Cap Ferret, south of Bordeaux, local telephone and telegraph systems were installed where required at the larger centres, at the bases of operation and at the various observation points. It was this network, and the splendid service which it rendered, to which naval officers ascribe a large share of credit for the splendid results achieved by the U. S. Navy,—constantly operating, as it was, off foreign shores and in unfamiliar waters.

And thus the A. E. F. net was spread.

* * * * * * *

Back in the States, the nation was literally "up on its toes."

It had been mobilised body and soul. Everyone was "in it," uniform or no.

Our army, for the first year, had reached the total of a million and a half men.

During the month which marked the opening of the Kaiser's final drive on Paris, 75,000 Americans found their way overseas. Upwards of 100,000 followed during the next month. Twice that number crossed in May, and the crescendo reached its peak in September, at nearly one-third of a million men, rushed across the Atlantic in a single month!

This couldn't have been done had not every possible element of force been exerted in the right direction back home.

Scarcely over a year before, the nation had been virtually dormant in the matter of military preparedness.

What a change in this brief period!

Faster and ever faster, events on the Western Front had been hastening to a climax.

Faster and ever faster, the effort of America had been hurrying to its apex.

And now, the great crisis at hand, America was ready to exert her utmost.

* * * * * * *

The Net was spread.

PART III

FIST

CHAPTER XXIX

EARLY ENCOUNTERS

The Signal Corps was essentially a combat organization, three-fourths of its troops serving at the front. At the time of the armistice, there were 1000 officers and 27,000 men of its personnel on duty with the armies at the front, and only 462 officers and 6038 men in the S. O. S.

—From the Official History of the A. E. F. Signal Corps.

Private Smith was nervous. Private Smith was worried. Private Smith was shaking in his hob-nail, issue boots. For Private Smith was in trouble.

As his name was called, he stepped forward, saluted, and promptly froze into attention. He knew what was coming. It was not going to be pleasant. No summary court proceeding ever is, not even to the summary court officer, least of all to the prisoner.

Smith had been provided with a copy of the charges against him. So he was prepared when the court officer, a sober looking lieutenant appointed for this purpose by the battalion commander, proceeded:

"Private Smith, you are charged with sequestering and destroying—er—consuming government property. Stealing and eating a carrier pigeon. Very serious offence. Do you plead guilty, or not guilty?"

Smith, resisting an impulse to scratch his head in an effort to facilitate thought, struggled to frame an adequate reply.

"That part, sir, about eating the bird—Yes, sir, guilty, sir. But about, now, this here see quest——"

"All right, guilty. Anything to say for yourself in defence?"

"Well, sir, I didn't think about its being a serious offence. I couldn't see what use the birds was, anyway, when we got the telephone. I heard Captain Blank say, sir, he'd swop all the pigeons his company could eat,—which was more pigeons, he says, than there was in the world,—for one single, extra camp telephone. Seems to me, sir——"

"Now listen here, Smith. Get this—and keep it. You have no business, under any circumstances, to misuse or destroy government property of whatsoever description. It is not up to you to question its usefulness. The Chief Signal Officer has a better conception of that, presumably, than you. As I said before, you have committed a very serious offence. I will take it this time, that you weren't aware how serious it was. Next time—if there is a 'next time'—you won't get off so easily. Whatever you do——"

The lecture was interrupted.

"Lieutenant wanted on the telephone, from H. Q., sir!"

The lieutenant stepped out. Smith turned to the orderly.

"They didn't send no pigeon for him, I notice," he said.

Smith's idea was not just Smith's. It pervaded the rank and file of the American Army: not the idea that pigeons were useless—those in a position to know never scorned the carrier pigeon—but the idea that when you wanted to get someone, right away, wherever he happened to be, the first thing you thought of was the telephone.

There were a number of compelling reasons for this.

First, national temperament and training. Back home, we had always relied upon the telephone as our first line of

offence and defence. That applied to all affairs alike, business or social. Instinctively, the American insisted upon the straight and shortest line between two points. That line happened to be the telephone.

Now war, to the American, was simply a special form of job. It was a mean job. The thing to do with it, was to get it done as quickly as possible. That, of course, meant the largest possible use of the telephone.

Added to this, however, were a number of special conditions making it essential that a large part of our communication at the front—and, for that matter, to the rear—be accomplished by telephone.

For one thing, there was the situation as to the mails. Every former member of the A. E. F. is only too familiar with the condition indicated by General Russel, when he refers to the fact that "the insuperable difficulties under which the American Postal Service of the A. E. F. laboured, emphasised the value of the wire service." [1] But still more compelling were the peculiar conditions demanding speed and certainty in communication at the front. "While telegraphy," observes General Russel, "played its part of great importance back of the Armies, this and the radio took a relatively unimportant part in the Corps and Divisions combat areas."

I remember talking to a chief liaison officer of one of our infantry brigades on the other side. Back home he was a newspaper man.

"You know," he said, as he puffed a commissary cigar and allowed a wrinkle of pique to form around his left eye,

[1] From an address delivered by General Edgar Russel before the New York Telephone Society, February 25, 1920.

"I'm only a lieutenant, and a lieutenant isn't supposed to know anything. I've recommended myself blue in the face on the subject of 'phone sets. For the entire brigade, there's only one camp set for liaison purposes. I could use five—easily. I've recommended to the General, at least six times, that I be allowed two more camp sets. The brigade commander has a set, but no one else can use it. The brigade adjutant has a set—well, we sneak into that once in a while. The brigade signal officer occasionally plugs into the board down in the cellar (dugout). And yet the General expects me to keep in touch with all the other P. C.'s, laterally, to the rear, with all other liaison outfits, and forward,—all with a single camp set.

"And you know what happens when Jerry sends over a few 'ash cans' and rips the line in a dozen places.

"When the sergeant reports, 'T.P.S. (*telegraphie par sol*) is down, sir,' I say, 'Oh, all right.' When he reports that the radio is out of order, I say, 'Still, or again?' When he reports that the blinkers are on the blink, I never blink an eye. But if he reports that the telephone is down, well, believe me, I begin to sweat!"

"Just how many telephone sets," I asked him, "do you estimate a brigade liaison officer really needs to do a one hundred per cent job?"

He looked at me a trifle belligerently. "All he can get!" he snapped back promptly.

Strange as it may seem, however, this predominant importance of the telephone at the front was not officially recognised by Army Regulations, in consequence of which signal battalions back home were religiously trained in wig

wag, semaphore and blinkers *ad nauseam,* in addition to a modicum of telephone and telegraph work.

Fortunately, as to a dozen of our signal units—the Bell Telegraph Battalions—and as to a large part of the others—especially the officers—this omission in training to take the telephone sufficiently into account, was not fatal. As to these men, the telephone training had already been acquired—before they entered the Army.

Apparently, therefore, Signal Corps training in the States involved a considerable waste of effort. Yet in view of what was known at the time, it is questionable whether this apparent waste could very well have been avoided.

At the time we were planning to take part in the great struggle, the war was still in the trench phase. When we actually came to take a decisive part, the great contest had developed into open warfare. The distinction between open and trench warfare is fundamental. Its bearing upon the relative use of the telephone and the corresponding character of Signal Corps training, is equally fundamental.

Open warfare is a warfare of movement. The field is constantly changing. The endeavour is always uppermost to drive the enemy back and off the fields. Troops try to keep in sight of, or surely in touch with the enemy. The action continues day and night, except for special cause. Artillery, machine guns, and the old standby—the rifle—are the master tools. There is no burrowing of trenches in the ground, except when a soldier scoops out a fox hole to sleep in. There is no sapping or mining. There is no such thing as underground wire works. The field is won or lost above ground and out in the open. And with movement so swift, units so widely scattered, instant intercommunication so

vital, the telephone is the heart and soul of every move. You *must* have communication with the other elements in the line, and to the rear, or you are lost. And you spend little time worrying as to whether the enemy will overhear your conversation. Suppose he does? By the time he gets ready to act on his information, it will be too late. Besides, he's too busy moving to spend much time in listening.

Consequently, in open warfare, American signal men, utterly abandoning the earlier form of underground, or of "stub" pole construction, developed by trench warfare, advance with the doughboys, stretch miles upon miles of "twisted pair" on the ground, or on hastily constructed telephone poles concealed in the woods, and consolidate newly acquired territory, telephonically, as rapidly as the infantry can gobble it up.

All this is in marked contrast to the type of stationary warfare in existence at the time American signal men were in training.

In trench warfare, there is the fixed series of trenches. These are sometimes within fifty yards of each other. Formations are not used. There is no manœuvring of troops. There is, in fact, no movement to speak of. A movement of several hundred yards is one to chronicle in the daily dispatches from the front. One seldom sees the foe. Fighting and raiding take place nearly always in the dark. The occupants of the trenches are split up into groups of specialists. There is the specialised work of throwing hand grenades, of sapping, of mining and counter-mining. Then there is the everlasting and harrowing job of keeping the wire fields in No Man's Land in constant repair.

Finally, there is the nicely adjusted and highly refined

work of "listening-in"—of maintaining posts for the purpose of detecting the smallest movement of the enemy.

This means two things: Overhear as much of the enemy's conversation as you can, and, Be as cautious as possible about your own telephone conversations.

It was on this account that the men at training camps back in the States were warned they would have to go light on the telephone when they got to the front.

There was a story current in Signal Corps circles during the war concerning a telephone message to the effect that "Petee Dink wishes to talk with Grizzly Bear." A listening German broke in, with, "Why don't you say Traub and Bullard instead of 'Grizzly Bear and 'Petee Dink'? Anyway Bullard is down the line at a conference."

Whether this story be true or not, it was certainly a case of diamond cut diamond, and the Americans proved by no means second best in this contest of wits. H. Blair-Smith, Assistant Vice President of the American Telephone and Telegraph Company, relates this episode which occurred in the 36th Division, commanded by his brother, Major-General William R. Smith. In Company E, 142 Infantry, there were 150 Indian soldiers, commanded by Captain E. W. Horner, of Mena, Arkansas. It became known that the Germans were successfully "listening-in" on wire communications of the American command. Captain Horner detailed eight Indians, in command of Chief George Baconrind, a son of one of the richest Indians on the Osage Reservation, to transmit the orders in Choctaw.

It was a distinct shock to the German code and language experts. These specialists from the land of Kultur boasted that no code or language known to man could pass their

scrutiny and remain unintelligible. Imagine their chagrin when this strange and incomprehensible gibberish came dripping into their ears in a stream of outlandish vowels and consonants the very nature of which they were unable to conjecture.

Throughout the entire front, it was necessary to camouflage all telephone conversations. Consequently telephone language, to the uninitiated, either aroused one's risibilities, or a sense of utter mystery.

"Hello, Bucket-of-Blood! Listen in on Tin Can! Heinie has the range on Podunk! Whizz-bang!"

Sometimes the use of code was very embarrassing. You were not allowed, for example, to call officers by rank. In the 26th Division, one day, a lieutenant on answering the telephone heard a voice, "This is Cole, come over to my billet."

"Sorry, old chap," was the reply, "I am a little bit feeble myself this morning. Suppose you come over to my billet. It's about the same distance from yours to mine, I believe, as it is from mine to yours."

"But this is Cole," persisted the voice, "I want you right away."

A faint glimmering began to flutter into the lieutenant's intelligence, as a rosy glow spread between his ears. He turned to a friend:

"Say, is General Cole in town?"

"Sure thing! Got in this A. M."

A kilometre of difficult going was covered in exactly five minutes. The lieutenant has never revealed what happened to him at the business end of that kilometre. He avoids the subject.

The German forces entrenched opposite the American lines were no less wary, for we had a "listening station service" of our own. To quote from The Official Signal Corps Report:[1]

Our listening-station service dates back to February, 1918, when the First Division took its place on the southern flank of the St. Mihiel Salient. It was natural that American personnel was desired on the listening service in this, the first American sector, as soon as our troops took their place in the line. The first two stations taken over from the French were at Marvoisin and at Seicheprey. The masses of ruins which bore these names were situated in the marshes between Beaumont Ridge and the high hill known as Mont Sec. In possession of a dominating series of heights, the enemy could at all times direct a heavy fire on any of the woods or villages before them.

The station at Marvoisin was a hole in the ground, and the one at Seicheprey was a hole above the ground. Here were installed amplifying apparatus, and thence radiated the wires attached to ground mats and rods planted in No Man's Land. This method of intercepting the enemy's telephone and ground-telegraph messages was a development of the initial endeavour of simply tapping the enemy telephone lines.

In the winter of 1914-15, when trench fighting became the order of the day, when every foot of ground was bitterly contested, and when lines were only 50 yards apart, the French Army's adventurous spirits evolved many methods of intercepting enemy communications. The most dangerous of these methods was the direct tapping of the enemy's telephone lines. But after the terrible costliness of close trench fighting was proved, the front lines began to drift farther and farther apart, a No Man's Land of barbed wire and pitfalls intervening.

Microphone and direct connection then became exceedingly difficult and new methods had to be evolved, using the principle of electro-magnet induction. A familiar example known to all is the overhearing on one line of the telephone conversations on another. By constructing loops of wire paralleling the enemy's lines of communication and magnifying, by means of an amplifier, the tiny electric currents induced in them, it was possible

[1] Report of the Chief Signal Officer to the Secretary of War, 1919, pp. 316-317.

to intercept the messages. In addition, copper mesh mats or metallic rods were buried as near the enemy's wires as possible, and wires led to the amplifier. By means of these grounds stray ground currents and leaks from enemy wires were magnified into audibility. In wooded country the air loops gave excellent service. Attached to tree tops, beyond ordinary detection, and quite close to the enemy lines, they rendered good results. In open country, however, this method could not be employed. Here, then, ground antennæs were buried. Where the terrain varied, both methods were employed.

The open Marvoisin and Seicheprey sectors permitted grounds only. And since almost every gust of artillery fire carried destruction, frequent repairs were necessary. The real danger during these repairs lay not so much in attracting fire to the men themselves—although many a time the line repairer would be sniped at or would have to work behind a protective crest in the face of a deluge of machine-gun bullets—but in the possibility of drawing fire elsewhere. No post commander cared to have artillery fire attracted to his defensive works nor upon an observation post. Working out in No Man's Land usually brought a concentration of machine-gun fire, and occasionally artillery fire in addition.

To the 406th (Pennsylvania Bell) Telegraph Battalion, fell the work, in March, 1918, of maintaining, in the face of shell and machine-gun fire, these circuits strung across No Man's Land to the listening posts. A section of Company D was first assigned to the work.

The historian of the 406th records:

The duty of this section was to bury out in No Man's Land mats of copper screening, approximately two feet by three, and connect these, by means of twist, to the listening apparatus in the dugout. Once the mats were planted the operators listened for messages, and the maintenance men made frequent excursions "over the top" to patch the wires, which were constantly being shattered by shell fire. In planting the mats and in subsequent maintenance, great dependence could be placed on the methodical plodding of the Boche mind. If a certain section in which a



STRINGING WIRE FROM ST. NAZAIRE TO NANTES



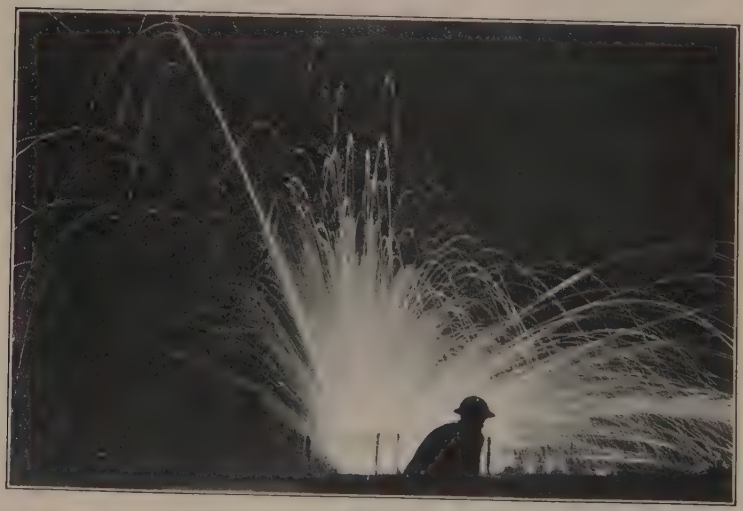
WIRE DERRICK ON THE LINE FROM ST. NAZAIRE TO NANTES

The contrivance shown in the above picture dips down first on one side of the pole, picks up all ten strands of wire, then moves along to the next pole, and by means of the see-saw effect sets them down again with perfect precision on the cross-arm, where a waiting lineman steers them into proper place.



U. S. Official

One reason why visual signaling gave way to the telephone. Smoke pots being set off by Lieutenant-Colonel B. C. Goss, Chemical Warfare Service, on the American front.



U. S. Official

"Down in Front". Field Signal telephone men almost invariably did their wire repairing at the front under cover of darkness, frequently interrupted by enemy flares and pyrotechnics, which meant instantaneous "flopping" to the earth, or another notch on the enemy sniper's rifle.

mat was to be placed, or wire repaired happened, at the time, to be under shell or machine-gun fire, a few observations on the interval of fire would suffice to determine when it would be safe to do the work. For example, if a volley splashed forth from the machine guns every fifteen minutes and lasted for one minute, it was comparatively safe to hop out from shelter immediately the firing ceased and work for ten minutes before again seeking shelter to await the next volley.

There was a large German power plant near the foot of Mont Sec, and this served to interfere greatly with the picking up of enemy messages. Later, however, when Western Electric amplifiers were received, radio messages were frequently picked up as they were sent from Berlin or the "Tour Eiffel." In the first days of service, however, its greatest good was to pick up conversations over the telephone between various Americans, the Boches rarely using the telephone in their forward areas; and in this way much careless conversation was detected and the talkers punished. In these forward areas, all names were coded and no titles used in telephone conversation other than mister. For example: if one wanted to speak to Colonel Schwartz, the Division Signal Officer at Menil la Tour, he would ask either for Schwartz or Mister Schwartz at "Maxey." Beaumont was "Boston," and there were other names like "Maine" and "Mississippi," which, when talking over the telephone, made one feel distinctly at home.

The first detail to be engaged in this maintenance work was in charge of Corporal Tritle, and included Alber, Devlin, Fennell, Lord, Noone, Peterson and Worrall. Later this detail was relieved by another from Company E, of the same battalion, headed by Corporal Drew, and including Custer, Gallo, Grindel, Henry, Leasure, McKay and McDonald.

It was the plan to work these men in shifts, four being on duty, two at each station, while the other four rested and regained a certain degree of nervous composure.

Tritle and Devlin opened affairs in a dugout at Xivray, near the foot of Mont Sec, and Lord was stationed some distance beyond Seicheprey. From these points they carried out, over the top, picks and shovels and other equipment, and planted the telltale mats, running the wires back to the posts. As Tritle later remarked, "We had plenty of everything but food; plenty of rats, plenty of cooties, plenty of shelling and plenty of gas."

The listening post men, not being part of any divisional organisation, nor under the close supervision of any of the officers,

were never warned when anything was likely to happen. Upon frequent occasions, the troops were withdrawn from the front line, after warning of an enemy raid, with never a word to these men, confined in an isolated dugout several hundred yards nearer Germany than any of the other American troops.

On one occasion a gas attack put the two operators out of business, although Peterson was fortunate enough to get into his gas mask before it was too late. The two casualties were immediately sent to the hospital, and for two days all Peterson could do was to sit in the dugout, watch the apparatus, which he did not understand, and telephone back to his lieutenant to send up more operators.

Long afterward, Peterson reluctantly told his story:

They took us in trucks to Beaumont, about a mile back of the line. This was the limit of daylight traffic on the roads which, known as "Dead Man's Curve," were at this point constantly visible from Mont Sec, the German stronghold, except where carefully camouflaged strips of burlap were stretched between the trees and painted to imitate grass.

The first night, the lieutenant said he had no place to put us, and we had better look around for a place to camp for the night. In an old house facing the road, just one room had been spared by shell fire; and we climbed through the window into a couple of empty bunks we found there.

Soon the shells started to explode at close range. The Boche shelled this road each night, dropping them over just often enough to make the hauling of supplies a mighty ticklish job. In the morning we were told that the house we had picked was the worst place along the road. Alber and I decided we had better look for a dugout. We found a little leaky dugout just big enough for two, which nobody seemed to have discovered, and there we dropped our blankets for the second night.

Next day Lieutenant Smith came to Beaumont and said that we were to take some supplies with us to our future home, to relieve two of our men who had been there for four days. The signboards were in French, and it was almost impossible to know which forks and turns to take. The ditches all looked alike. Although the trenches from Beaumont to Seicheprey were not so large, they were pretty well duck-boarded and drained.

At Seicheprey, we loaded up with coils of wire and storage batteries and candles and globes, and started on the next hop to the front. It would have been bad enough with nothing to carry, as in many places the sides were caved in, making a pile of mud in the bottom of the trench. The duck-boards were busted, and in some places entirely missing; water had accumulated from the winter rains and snows to a depth of eight or ten inches for a distance of a hundred yards at a stretch. If you happened to put your foot in the wrong place or in a hole in the duck-board, you would go down to your knees in mud. We had to squeeze through narrow places with our loads, and, I'll tell you, it was some little trip.

The new home which we reached was a beauty. The floor was about a foot below the bottom of the trench, and the ceiling some five feet from the floor, the room being about six feet square. There were two stationary bunks, a chair and a board nailed to the wall for a table, and on the board, an amplifier and globes for picking up messages. When you stepped on some of the boards in the floor you started a miniature geyser and this home was on the communication trench about fifty yards from the front line.

We looked the place over and rested a few minutes, then started back to Seicheprey for another load of stuff. We had quite a job finding our way back. Fennell did lose his way, and he had to get out on top and look the ground over, getting worse mixed up than ever and finally taking about two hours to find his way in. He was lucky at that; he might have had a couple of shells bounced at him, and not found his way at all.

When I relieved Devlin at this post, I was just too late to get any chow, and when it came again, I didn't get any either. They brought the stuff out from Seicheprey, where it was cooked in fireless cooker cans, and these kept the chow pretty warm, if the carriers didn't get tired and stop somewhere. The carriers on this particular night were new to the business, and decided it was easier to walk on top, than to slip and slide around over the duck-boards. Fritz spotted them, and just as they had taken the lid off the can, he put a "77" on top of the parapet where we were standing and dumped a load of mud and debris into the can and over us.

The next day I received my instructions. All we had to do was to plant a piece of copper screening about two feet square just as close to the German lines as we could get it, then hook

one end of a coil of twisted pair to the terminals on the mat, then walk back to the dugout with the other end of the coil, and then, after that, all we had to do was to shoot trouble on that line and on the lines to the five other mats in the neighbourhood.

The first night Fritz must have been trying to make somebody think that he was going to pull off a raid. He dropped over about three thousand shells, naturally right behind the front lines, and every whiz sounded as if it was coming right for the roof of our dugout, but we got nothing worse than the pieces thumping against our blanket that served as a door. In the morning we started out to see what had happened.

Trouble! If it were not for the work of hauling the wire out from Seicheprey and running it through the barbed wire, it would have been a whole lot easier to run all new loops. Every circuit was cut at least twenty times.

I saw right there where I had some job. But luckily, that didn't happen every night. The rest of the day all I had to do was take that walk back to Beaumont and get some new storage batteries. I had always had the idea that a quiet sector was a place where days at a time would go by without anything happening. Maybe that is what they do call "nothing," but it did not seem like "nothing" to me. For every night there would be a half hour's firing, pretty heavy firing, too, and then it would dwindle down to one about every five minutes. Then in the middle of the night the gas alarm would go off, and you'd have to lay there half awake with a gas mask on for fifteen or twenty minutes till the "all clear" came. This happened sometimes once, sometimes three or four times in a night.

The third night we saw a bunch of doughboys coming out of the front line and we asked them what was up.

"Oh, nothing," they said.

Well, we told one of the machine gunners, who had a dugout just across the trench from us, to tell us if anything happened.

He said: "Oh, you'll know all right—when you hear our gun you'll know it's time to go, for we are a rear guard, to cover retreats."

Well, we would have been waiting yet, if we waited for that gun, for all the troops were called out of the front lines that night, in expectation of an enemy raid, and the machine gunners pulled out and never said a word to us.

We woke up the next morning a quarter of a mile out in "No Man's Land," with all our troops behind us. About nine o'clock

they came in again, and the machine gunners informed us that they had forgotten all about it. I guess we would have forgotten all about it, too, if that raid had been pulled off.

* * * * * * *

Thus early in the game were the Bell Battalions represented at the front by these adventurous eavesdroppers out in No Man's Land. Others were to follow; virtually half, in fact, of all the Signal Corps telegraph battalions (as distinguished from the field signal battalions) were to be assigned to corps and army work.

Of these, the 406th was the first. Its assignment to the combat zone followed closely on the heels of a new organisation in the A. E. F.

General Order No. 9, January 15, 1918, had created the First American Army Corps,—the first such organisation, in fact, since the close of the Civil War. This order named, as Corps Commander, Major-General Hunter Liggett, and assigned as Line Divisions the first four divisions to land in France: the 1st and 2nd Divisions, the 26th or Yankee Division, and the 42nd or Rainbow Division; the 41st Division being designated as a Replacement Division. On January 20th the Corps, with headquarters at Neufchâteau, took over the administrative command of the 1st Division in line in the Xivray-Flirey sector, and shortly afterward, of the 2nd Division, holding the sector between Dieue and Spada, of the 42nd Division holding the Luneville-Baccarat sector, and of the 26th Division, then along the Chemin-des-Dames. Each of the divisions remained for the present under the tactical command of the various French Corps to which they had been assigned.

On February 17, 1918, the 406th Telegraph Battalion

was assigned as the First Army Corps Telegraph Battalion.

The 406th Battalion lost no time in getting to work on its new assignment.

On the morning of February 29, 1918, members of Company D, of the 406th Battalion, assigned with the 1st Division at Boucq, under the French 32nd Army Corps, got their first taste of a German barrage.

While forward lines were being surveyed and materials for these were being collected by one section, another was erecting two circuits between the French exchange at Toul and the 1st Division switchboard at Menil-la-Tour, ("Maxey"). These circuits were placed on French poles, and they went up "as if by magic,"—to use the expression of an interested French observer.

Soon the forward circuits were started, and these were tackled with a will. At last, no rights of way to be considered! Speed of construction and accessibility for road maintenance: these were the chief factors. But—the line led straight across fields from the hill at Boucq toward the woods to the north, always in plain view of the Boche positions on their all-commanding Mont Sec. The main line terminated at the woods south of Ansauville, and a branch comprising several circuits of "twist" ran to the dugout at Raulecourt, the open wires leading toward Ansauville, connecting with a line being erected by the Division Signal Battalion.

Before long the entire area was transformed, telephonically speaking.

The American telephone had invaded the front.

It was a transformation for which the 406th and other telegraph battalions can by no means claim a monopoly of

credit. There was another branch of the Signal Corps that left an equally bold imprint on the French telephone front: the division field signal battalions. It would be difficult to overstate the enterprise and daring displayed by the officers and men of these advance field outfits. We have space in this connection for but a single instance, taken from the experience of Major K. D. Schaffer, of the Central Union Telephone Company, who commanded the 307th Field Signal Battalion attached to the 82nd Division.

The latter, acting as a part of the 8th French Army, 32nd Corps, had no sooner taken over an important sector from the French, than they got busy completely revamping what seemed to them a hopelessly inadequate system of telephonic communication. We will let Major Schaffer tell his own story.

The French had a general plan for installing buried cable on this front, that was to be carried on by divisions occupying the sectors.

This plan, in general, consisted of four antennæ routes, one through each regimental area, and two lateral routes in each Divisional Sector.

It seemed that they expected the front to remain unchanged indefinitely, as a slight movement either forward or back would throw the whole scheme out of kilter.

At any rate, I was called into conference, and the next section of cable to be laid was indicated. It consisted of a 30-pair run from a Brigade P. C. to a Regimental P. C. on the Division axis of Liaison, a distance of about 5 kilometres.

About this time, I discovered a big ditching machine at the engineer dump, which we tuned up and put on the job. It would put down a 6-foot ditch at about 50 feet per hour. We started at the Regimental P. C. end of the job, and as the first kilometre was in sight of the Boche observation balloons, we could work only after dark and had to camouflage the ditch and machine through the day.

We had been working several days when the French asked if I had my plans about ready. When I told them the work had started, I thought I was going to be shot at sunrise. It seemed that I was supposed to submit detail plans which would go to the Corps and then to Army Headquarters for approval, after which the work would start.

They had expected to have the job completed in about six months. We finished it and had the cable cut into service in fifteen days.

We used 10-pair lead covered paper cable of American manufacture, which was laid in the ditch after the bottom was smoothed and then the ditch filled in. Details from the Infantry were used for refilling. Splices were made in a small wooden box which was filled with compound, as no material was available for putting on lead sleeves. "In" and "out" terminals were placed every kilometre, and these were also improvised by using a box which was filled with compound, the wires being brought out through holes drilled in the side and terminated on lock-nut strips.

When the job was finished, the French were so elated that I was forgiven for doing it instead of talking about it.

And so the most striking American contribution, perhaps, noticeable at the front in the early days of our participation, was the completely overhauled system of telephone communication. It showed up right from the start. And this meant, of course, in the early days of trench warfare, a new factor in the effectiveness, despatch and relative saving of lives with which a raid was conducted.

For "listening-in" was a more or less bloodless substitute for a raid. Under the old system, when you wanted to know what the enemy was doing, you made a raid with a view to capturing a number of prisoners and pumping them dry of all the worth-while information they might possess. Latterly, raids came to be made chiefly to check up and prove the correctness of information secured by "listening-in."

And during the course of a raid, or even of a large en-

gagement, it was by means of the telephone that the entire progress of the action was controlled.

"No man in the world," a Colonel directing one of these raids in the American sector during the early days, advised Floyd Gibbons, war correspondent for the Chicago *Tribune*,[1] be he correspondent or soldier, could see every angle of even so small a thing as a little raid like this. What you can't see you have got to imagine. I'm suggesting that you stay right in here for the show. That telephone on my adjutant's desk is the web centre of all things occurring in this sector to-night and the closer you are to it, the more you can see and learn."

And then, further on,[2] in his characteristically vivid style, Gibbons describes the raid as viewed through the telephone.

Five minutes before the hour, I stepped out of the dugout and looked at the silent sky toward the front. Not even a star shell disturbed the blue-black starlight. The guns were quiet. Five minutes more and all this was to change into an inferno of sound and light, flash and crash. There is always that minute of uncertainty before the raiding hour when the tensity of the situation becomes almost painful. Has the enemy happened to become aware of the plans? Have our men been deprived of the needed element of surprise? But for the thousands of metres behind us, we know that in black battery pits anxious crews are standing beside their loaded pieces waiting to greet the tick of 2:30 with the jerk of the lanyard.

Suddenly the earth trembles. Through the dugout window facing back from the lines, I see the night sky burst livid with light. A second later and the crash reaches our ears. It is deafening. Now we hear the whine of shells as they burn the air overhead. The telephone bell rings.

"Yes, this is Boston, the Adjutant speaks into the receiver. We

[1] "And They Thought We Wouldn't Fight," by Floyd Gibbons, 1918, George H. Doran Company, page 253.

[2] Gibbons, pp. 255-ff.

listen breathlessly. Has something gone wrong at the last minute?"

"Right, I have it," said the Adjutant, hanging up the receiver and turning to the Colonel: "X-4 reports barrage dropped on schedule."

"Good," said the Colonel. "Gentlemen, here's what's happening. Our shells are this minute falling all along the German front line, in front of the part selected for the raid and on both flanks. Now, then, this section of the enemy's position is confined in a box barrage which is pounding in his front and is placing a curtain of fire on his left and his right and another in his rear. Any German within the confines of that box trying to get out will have a damn hard time and so will any who try to come through it to help him."

"Boston talking," the Adjutant is making answer over the telephone. He repeats the message. "233, all the wire blown up, right."

"Fine," says the Colonel. "Now they are advancing and right in front of them is another rolling barrage of shells which is creeping forward on the German lines at the same pace our men are walking. They are walking in extended order behind it. At the same time our artillery has taken care of the enemy's guns by this time so that no German barrage will be able to come down on our raiders. Our guns for the last three minutes have been dumping gas and high explosives on every battery position behind the German lines. That's called 'Neutralisation.'"

"Boston talking." The room grows quiet again as the Adjutant takes the message.

2:36. "Y-1 reports O. K."

"Everything fine and dandy," the Colonel observes, smiling.

"Boston talking." There is a pause.

2:39. "G-7 reports sending up three red rockets east of A-19. The operator thinks it's a signal for outposts to withdraw and also for counter-barrage."

"Too late," snaps the Colonel. "There's a reception committee in Hades waiting for 'em right now."

At 2:40 the dugout door opens and in walks Doc. Comfort from the Red Cross First Aid Station across the road.

"Certainly is a pretty sight, Colonel. Fritzie's front door is lit up like a cathedral at high mass."

At 2:41. "A very good beginning," remarks a short, fat French

Major, who sits beside the Colonel. He represents the French Army Corps.

2:43. "Boston talking—Lieutenant Kernan reports everything quiet in his sector."

2:45. "Boston talking," the Adjutant turns to the Colonel and repeats, "Pittsburgh wants to know if there's much coming in here."

"Tell them nothing to amount to anything," replies the Colonel, and the Adjutant repeats the message over the wire. As he finished, one German shell did land so close to the dugout that the door blew open. The officer stepped to the opening and called out in the darkness:

"Gas guard, smell anything?"

"Nothing, sir. Think they are only high explosives."

2:47. "Boston talking—enemy sent up one red, one green rocket and then three green rockets from B-14," the Adjutant repeats.

"Where is that report from?" asks the Colonel.

"The operator at Jamestown, sir," replies the Adjutant.

"Be ready for some gas, gentlemen," says the Colonel. "I think that's Fritzie's order for the stink. Orderly, put down gas covers on the doors and windows."

I watched the man unroll the chemically dampened blankets over the doors and windows.

2:49. "Boston talking—23 calls for a barrage."

The Colonel and Major turn immediately to the wall map, placing a finger on 23 position.

"Hum," says the Colonel. "Counter-attack, hey? Well, the barrage will take care of them, but get me Watson on the line."

"Connect me with Nantucket," the Adjutant asks the operator. "Hello, Watson, just a minute," turning to Colonel. "Here's Watson, sir."

"Hello, Watson," the Colonel says, taking the receiver. "This is Yellow Jacket. Watch out for counter-attack against 23. Place your men in readiness and be prepared to support Michel on your right. That's all," returning 'phone to the Adjutant. "Get me Mr. Lake."

While the Adjutant made the connection, the Colonel explained quickly the planned flanking movement on the map.

"If they come over there," he said to the French Major, "not a God-damn one of them will ever get back alive."

The French Major made a note in his report book.

"Hello, Lake," the Colonel says, taking the 'phone. "This is Yellow Jacket. Keep your runners in close touch with Michel and Watson. Call me if anything happens. That's all."

3:00. "Boston talking—G-2 reports all O. K. Still waiting for the message from Worth."

3:02. "Storming party reports unhindered progress. No enemy encountered yet."

This was the first message back from the raiders. It had been sent over the wire and the instruments they carried with them and then relayed to the Colonel's command post.

"Magnifique," says the French Major.

3:04. "Boston talking—X-10 reports gas in Bois des Seicheprey."

3:05. "Boston talking—Hello, yes, nothing coming in here to amount to anything. Just had a gas warning but none arrived yet."

3:07. "Boston talking—Yes, all right" (turning to Colonel), "operator just received message from storming party 'so far so good.'"

"Not so bad for thirty-seven minutes after opening of the operation," remarks the Colonel.

"What is 'so far so good'?" inquires the French Major, whose knowledge of English did not extend to idioms. Someone explained.

3:09. "Boston talking—Watson reports all quiet around 23 now."

"Guess that barrage changed their minds," remarks the Colonel.

With gas mask at alert, I walked out for a breath of fresh air. The atmosphere in a crowded dugout is stifling. From guns still roaring in the rear and from in front came the trampling sound of shells arriving on German positions. The first hints of dawn were in the sky. I returned in time to note the hour and hear:

3:18. "Boston talking—O-P reports enemy dropping line of shells from B-4 to B-8."

"Trying to get the boys coming back, hey?" remarks the Colonel. "A fat chance. They're not coming back that way."

3:21. "Boston talking—23 reports that the barrage called for in their sector was because the enemy had advanced within two hundred yards of his first position. Evidently they wanted to

start something, but the barrage nipped them and they fell back fast."

"Perfect," says the French Major.

3:25. "Boston talking—two green and two red rockets were sent up by the enemy from behind Richecourt."

"Hell with 'em, now," the Colonel remarks.

3:28. "Boston talking—all O. K. in Z-2. Still waiting to hear from Michel."

"I rather wish they had developed their counter-attack," says the Colonel. "I have a reserve that would certainly give them an awful wallop."

3:30. "Boston talking—more gas in Bois des Seicheprey."

3:33. "Boston talking—white stars reported from Richecourt."

"They must be on their way back by this time," says the Colonel, looking at his watch.

3:37. "Boston talking—enemy now shelling on the north edge of the town. A little gas."

3:40. "Boston talking—K-1 reports some enemy long range retaliation on our right."

"They'd better come back the other way," says the Colonel.

"That was the intention, sir," the Lieutenant reported from across the room.

3:42. "Boston talking—Signalman with the party reports everything O. K. "

"We don't know yet whether they have had any losses or got any prisoners," the Colonel remarks. "But the mechanism seems to have functioned just as well as it did in the last raid. We didn't get a prisoner that time, but I sorter feel that the boys will bring back a couple with them to-night."

3:49. "Boston talking—G-9 reports some of the raiding party has returned and passed that point."

"Came back pretty quick, don't you think so, Major?" said the Colonel with some pride. "Must have returned over the top."

It is 3:55 when we hear fast footsteps on the stone stairs leading down to the dugout entrance. There is a sharp rap on the door, followed by the Colonel's command, "Come in."

A medium height private of stocky build, with shoulders heaving from laboured breathing and face wet with sweat, enters. He removes his helmet, revealing disordered blonde hair. He faces the Colonel and salutes.

"Sir, Sergeant Ransom reports with message from Liaison

officer. All groups reached the objectives. No enemy encountered on the right, but a party on the left is believed to be returning with prisoners. We blew up their dugouts and left their front line in flames."

CHAPTER XXX

THE FINAL DELUGE

The spring of 1918 marks the high tide of the Teuton. Fortune seemed to lavish her warmest smile upon the Prussian legions. Everything apparently favoured the prospect of an overwhelming German victory. The eastern front had ceased to exist as a menace to the Kaiser. The Balkan situation had resolved itself entirely in favour of the Central Powers. The sway of the War Lord now extended from Schleswig-Holstein to Palestine. Ludendorff found himself in a position where he could strike apparently at will. The initiative was his. The Allies had completely resigned it. They were on the defensive. They apparently intended to remain so. It was low tide for the Allies.

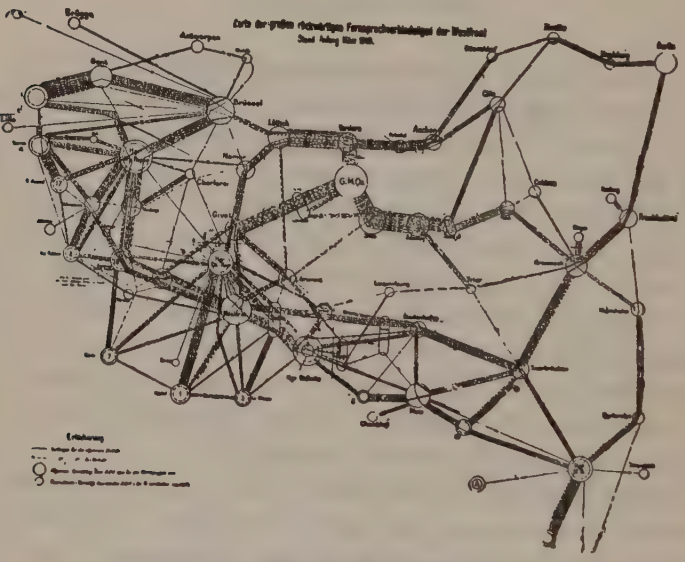
It became clear to Ludendorff that now, if ever, was the time to bring the war to a speedy conclusion. He could not fail to see that, although immediate advantage in superior strength was his—he opposed 207 divisions to 177 of the Allies—there lay always in the background the American possibility. What that was, no one, of course, could say; but it was a factor, and had to be taken into account.

It was up to Ludendorff to achieve victory before the Americans came on the scene in any sort of force.

Hence Ludendorff's decision for a final trial of strength in March, 1918. Hence the great deluge that broke loose on March 21st, swept first across Picardy, then, to the north,

across the plains of Flanders, finally, to the south, in the direction of Paris.

Ludendorff's strategic purpose was nothing less than to destroy the British Army and thus break the British will for war. He was to do this, if possible, by a single blow. If he



ALL SET "NACH PARIS"

Map of German telephone system as it stood just before the opening of the German Spring drives in 1918. This map is said to have been taken off the person of a dead German officer. It shows the leading telephone lines from Berlin to the rear of the western front.

failed in this, his purpose was to isolate the British from the French, and then to prepare the way for a second blow in an effort to crush the British. If he could achieve this with any measurable degree of success, he had no doubt France would be quick to recognise the wisdom of suing for an immediate peace.

The first blow, therefore, fell upon the British in Picardy. Pouring in a mighty torrent on either side of the Cambrai salient, the Prussian legions threatened actually to accomplish their purpose of destroying the British Army. The battle of Picardy was the worst defeat in British history. The Fifth British Army was demoralised, and General Gough, its commander, was promptly recalled.

But bull-dog tenacity won out, and the onslaught failed to shatter the British Army as had been anticipated: it fell just short of that. And this became clear by April 6th, or 16 days after the opening of the German attack, on which day the Picardy offensive terminated.

Failing in the destruction of the British Army, Ludendorff tried again,—a bit further north this time. The attack began on April 9th, having for its objective Amiens and, therefore, traversing the fields of Flanders. Again Ludendorff registered huge gains, again he inflicted demoralising losses on the British, and again he was all but successful. The force of the Prussian blow was spent by April 27th. The British hung on just long enough for the French reserves, under Fayolle, to arrive and save the situation from an utter debâcle.

Ludendorff had failed, for the time, to accomplish his programme. But he did accomplish an enormous depression in Allied morale. The Allied world was plunged in deepest gloom.

And then, to add to all this, comes the culminating disaster.

Ludendorff has recognised that he must shift the scene of action. If he can but draw the French reserves away from the British, he may try again. One or two more onslaughts may supply the finishing touches to the British.

So, after waiting a month, he makes a grand feint in the direction of Paris. He launches a stroke against the French and British on the Chemin-des-Dames. This is on May 27, 1918.

It is a momentous engagement. Ludendorff has found an exceedingly vulnerable spot in the Allied line. The Teuton host tumbles through in a mighty avalanche whose speedy advance takes not only the French and the British by complete surprise, but amazes Ludendorff himself.

In a trice, the Germans are at the Marne, the path to Paris lies open, it seems like the end after all. Civilisation is about to go into eclipse. *Welt-Kultur* impends.

In the meantime, with the British and the French struggling under the divided leadership and headed straight in the direction of disaster, Foch has been given supreme command of the Allied forces.

With headquarters established at Senlis,[1] Foch has taken hold at once. From Clemenceau and Milner, representing the French and British Governments respectively, he has received unlimited military authority. Pershing, with Wil-

[1] Incidentally, it was an American signal officer, Captain A. L. Hart, of the Wisconsin Telephone Company, who installed the telephone facilities at Foch's headquarters at Senlis. It was not the first time Foch expressed his preference for the American telephone. Time and again the great French strategist would go out of his way in the field to obtain an American telephone connection, if one was available to the point desired.

Hart relates a curious circumstance in connection with this installation at Senlis:

"While installing facilities at Marshal Foch's headquarters at Senlis, I was told that the only man who could give me the whereabouts of certain conductors to be used in a cable was dying of influenza. As this information was imperative, I sought the ill-fated Frenchman, and by the aid of his aged mother, who spoke a little English, I obtained the information necessary to enable us to proceed with the work."

son's approval, has followed suit. "All that we have is yours," he tells Foch; "use it as you wish."

What were these forces thus placed at Foch's disposal, and what did they amount to?

The First Division had arrived in France in June, 1917; the Second Division had followed in August, 1917; September saw the arrival of the 26th or Yankee Division; November brought the 42nd or Rainbow Division; in December, 1917, the 41st, and in February, 1918, the 32nd Division had arrived, while March saw the arrival of the 3rd and 5th, both Regular Divisions.

Eight American divisions, seven of them fighting units, one of them a replacement division, and only four—the 1st, 2nd, 26th and 42nd—even partially trained!

What evidence of fighting prowess had these American troops given to encourage the Allies in their present plight?

Up to the latter part of May, 1918—practically none.

For the experience of these four divisions in the trenches was largely a matter of schooling, more than anything else.

The first real rub between the Americans and the enemy had come in April, 1918. Foch had called upon Pershing for the 1st Division. It went into action with the British on the ridge north of Montdidier, covering the Paris-Calais Railway, and immediately in front of the town of Cantigny. The 26th or Yankee Division had relieved the 1st Division in the Toul sector, and it was here that the first considerable American skirmish took place, at a ruined village in the Woevre Plain named Seicheprey.

This first skirmish is notable for several reasons.

"During the engagement," runs the official account, "the Germans concentrated their artillery fire on the American

telephone and telegraph wires, which were cut many times. Couriers were forced to pass through two or three barrages to maintain communication. In the meantime the men of the Signal Corps, many of them smoking cigarettes in the face of a heavy bombardment, restored the wires almost as fast as the enemy disrupted them."

Our old friends of the 406th (Pennsylvania Bell) Telegraph Battalion engaged on listening post work, found themselves in the very thick of the fray. One of these, Gallo, trapped in the Boche raid, has given an interesting picture of the engagement:

On April 21st, the Germans pulled off an attack, the barrages started at three o'clock in the morning and kept on advancing. About five-thirty or six o'clock, the barrage passed over us, the Germans were soon all around us, past us and everywhere, but some way or other they missed our place. Our station was kept working until about six in the morning, but then the noise was so terrific and our lines were shot up so many times and the Germans were at our door, so we could do nothing. Our orders were to keep the station going as long as possible. The day before we had received a Western Electric amplifier and telephones and had specific orders, in case of an attack, or of being cornered, to dismantle the station and destroy instruments before the Germans got hold of them. So we had everything in readiness to destroy all instruments. The station records I hid under some stones near our place. At seven o'clock, our station was reconnected, as the Germans were pushed back and imminent danger of their getting equipment had passed.

The first night following the battle we gathered up all the reinforcements we could get, some artillery men, some infantry men and two or three runners, in all a force of about thirteen or fourteen men. We had our pistols, one automatic rifle and seven or eight ordinary rifles and a few grenades. Starting at five in the afternoon, every man of our force had to stand one hour watch during the night. Another barrage started about three-thirty, but only lasted a few hours. This night we were prepared for almost anything but nothing turned up.

The day after the raid our Lieutenant had searched everywhere, all the field hospitals and bases as well, but could not get us located, so they finally gave us up, either killed or captured, but at last they located us and we were ordered out, dismantling the station altogether.

Such was the behaviour of Gallo and his fellow-members of the Signal Corps during the Seicheprey affair that the Chief Signal Officer, in a special letter, took occasion to commend them for their "coolness, steadfastness and resourcefulness under trying conditions."

The infantry side of the picture is furnished by Corporal McHugh of The Southern New England Telephone Company, attached to the 102nd Infantry, Yankee Division, Companies C and D of which bore the brunt of the attack:

We finally wended our way toward the front lines again the night of April 19, 1918. This time we were going to Seicheprey, some to death, some to be crippled, and some to capture. On our way in, of course, we took the long way. We didn't pass Dead Man's Curve that night, and it was well for us that we didn't, as many of us would never have reached the lines. There were shells of all sizes glancing off that road as we continued on in single file. I cannot give you an adequate picture presented by a single file straggling to the front. The nearest thing to it would be a huge snake. All you could hear was footsteps splashing in mud and water. Most of the journey was over the top, until we got near the lines. And if you only knew what was in those boys' hearts! Some were light-hearted, some heavy-hearted, some had the feeling they were facing death and this was their last trip. Others were positive they would only get wounded. Some didn't seem to care. They took life just as it came. I won't say I am not afraid of death. I've faced it many times and not once did I have the feeling that it was near me. I left America with the feeling that I was coming back. I read once in French history that every soldier goes into battle feeling that he will come out alive. It may be so, but I have seen fellows go in with the feeling that they weren't coming out.

We finally arrived in the front lines again, and the strangest

part of it was we weren't bombarded, which was something unusual, for every time relief came in they were shelled, but there were other things in the wind.

I was given an outpost with sixteen men, all automatic riflemen. We set up one rifle with four men in advance, and one was guard in the rear. At eleven o'clock the rest went into an elegant iron dugout which wasn't shellproof. Three o'clock the men on post were to be relieved. At two forty-five a. m. a violent barrage was thrown to the rear of us. The gas alarm was sounded. I came out of the dugout but couldn't smell any gas, so as it was near the time for relief I took four men and went forward and left a Corporal in charge of the others, telling him if anything turned up to reinforce me in the front and we'd hold the position till the rest of the platoon came up. I kept eight men and myself in the front, and I must tell you we were in a salient and the Germans were on three sides of us. At eight-fifteen the fire shifted and we got the full force of it. What trenches were there before soon disappeared. This fire kept up for an hour, and when it lifted we were in shell holes, not trenches. I told the men as soon as it lifted to mount the parapet and give it to them. I say parapet. There wasn't much of that left. At about four-fifteen the Boches followed their barrage, coming out of an old trench directly ahead of us, about 50 yards. We opened up on them and they went back. We held overwhelming forces off for about an hour and a half, and we were outnumbered so much we had to retreat. All but one man was wounded, and we only had one automatic left, so I sent the men to the rear one at a time. The platoon that was to reinforce us never came up. They had their hands full on a flanking attack.

When I left the front the only weapon I had was a Colt's pistol, and I looked for the dugout on my way back, but it was gone, blown up, and the Germans following us up were playing the devil with machine guns, which played "Nearer, My God, to Thee" around my head. I met one of the boys on the top of a trench and I hardly had time to say anything to him when a bullet through the head finished him. A little further I met one of the men that was with me and he said that we were surrounded. My arm and shoulder at that time started to pain something terrible. As the only soldiers I saw were dead I thought we were the only ones alive. Then we came across a pile of dead Jerries. Looked as though some of the boys put up a fight. At one o'clock on the Germans' return, that is, they were being beaten back,

they picked us up and hurried us off to their lines. That was some trip crossing No-Man's Land with the American artillery beating down on it and the hundreds of dead Jerries that were killed lying scattered all around. I believe the sector that was attacked had about three hundred men in it, and the Germans numbered over two thousand, and lost nine hundred killed and wounded. That was told to me by a German officer. He also said that the Americans fight like hell. "You are foolish," he said. I was told afterward that out of two hundred men in my company, only sixty were left after the battle.

Seicheprey has been characterised by Simonds as "a score for the Germans but a credit to the fighting spirit of the Yankees." But it was a mere fleabite, compared to the awful carnage then raging in Flanders, and it passed almost unnoticed. It certainly meant little to the Allies.

The true promise that lay in American arms was not revealed until a month later.

The 1st Division, as previously stated, had taken up its position with the British before the little town of Cantigny, the centre of a small salient projecting into the Allied line west of Montdidier. Orders to the 1st Division were to hang on. Mere "hanging on," began before very long to pall on these restless and intrepid spirits. After a month of it, the impatient warriors left their trenches, and by a brilliant movement executed within 48 hours, took the town of Cantigny—and held it.

This was on May 28th—the day after the Allied disaster on the Chemin-des-Dames—the day of deepest gloom in the crumbling ranks of the Allies. It was a purely local affair that the Americans had started on their own initiaive, but it had been carried off with such swift and splendid élan, that the effect was electrical, and was felt all along the Allied line.

Isolated as this movement was, it could not but influence Foch's calculations. Much, indeed, followed largely as a result of it: the determination to rely upon American troops at Château Thierry; the consequent "plugging of the gap"; Belleau Wood, and the subsequent stemming of the Noyon-Montdidier and Champagne-Marne tides; the resultant decision for a grand Allied counter-offensive, leading in turn to the great Allied coup in the Château Thierry pocket; the German rout; St. Mihiel; the Meuse-Argonne; the breaking of the Hindenburg line; Armistice.

It was as if Fate had purposely laid the cornerstone at Cantigny, each succeeding stone to rest upon the one immediately beneath, until the final edifice, with Kultur securely immured therein, was completed at Rethondes on November 11, 1918.

Cantigny was not an accident, and the work of the signal troops was the least accidental part of it. Cantigny was, in fact, a carefully planned affair. No "show" was ever preceded by a more thorough-going series of dress rehearsals. This will be evident to anyone who will take the trouble to read the Chief Signal Officer's account of this action.

The actual attack was largely made by the 28th Infantry, supported by French tank battalions, a platoon of French flame throwers, and a small force of First U. S. Engineers. The signal preparations were conducted largely by the 2nd Field Signal Battalion, supported by outside expert assistance.

On the morning of May 25th, the commanding officer of the 411th (Pacific Bell) Telegraph Battalion received an order to rush a small detachment of expert linemen, under command of an officer, to assist the signal officer of the First Division in preparing the lines of communication on the

proposed Cantigny offensive. Lieutenant A. B. Coates [1] and a detachment of 15 men were hurried across country by motor truck, and besides rendering efficient service in keeping up communications, had the opportunity of installing telephone service in temporary headquarters erected for Marshal Foch and General Pershing.

Not all the expert telephone men engaged at Cantigny, however, were attached to the Signal Corps, although some of those who were not, inevitably found their way into their old accustomed telephone channels. For example, there was the case of Oscar A. Bondelid, a trained telephone man from the Northwestern Bell Telephone Exchange Company, who was on active duty with the 3rd Machine Gun Company of the 1st Division, but who, because of his telephone experience, was assigned to the signal detachment as a telephone man. His story is of considerable interest:

> The first intimation that I got that the Americans were going to put over an attack on the Germans was when the Major, in speaking of certain work to be done at the front, remarked that I had better look over my instruments and reels and see that they worked. As the Battalion in ordinary trench warfare was hooked up to various infantry companies and in open warfare worked as an independent unit, I figured that we were scheduled to go over the top pretty soon. It did come soon enough. One evening we started up with all our equipment. We arrived at the front about eleven o'clock with instructions to hook up the divisional P. C. and the P. C. of our Major who had established himself on a hill with several machine guns which were using what they called indirect fire on the Germans.
>
> The line ran through a valley which ran straight to the front. Anyone who was at Cantigny remembers this valley. It was the worst place to make a man work in that I ever saw at the front.

[1] A. B. Coates, later captain in command of Company D of the 411th Telegraph Battalion, ultimately took charge of this battalion on its homeward voyage, Major Moore having been detailed for duty with the Army of Occupation.

It was valuable as a communication line and the Boche knew it and shelled the deuce out of it on the slightest provocation.

Well, we got the line through. The night was quiet as it could be. Once in a while the sharp crack of a sniper's rifle or the rattling staccato of a Hotchkiss machine gun fired by Americans disturbed the quiet. The dull answer of a heavy German Maxim with its pum-pum-pum, in such contrast to our vicious little guns, made us laugh. It was the German way to make everything as heavy as it could be made, even a sound.

Due to an error on the part of our supply officer we had only enough wire to run a grounded circuit, using a bayonet at one end and a hand axe at the other, for earth connections. Of course, as this was strictly against orders it had to be remedied as soon as we could get more line; but we had orders to get the line working and we carried out those orders first.

We then quit work and found a small dugout large enough for two of us. We were awakened by the barrage being thrown over by all the guns in creation, it seemed. We could easily see the front from where we were, and after awhile our tanks lumbered out of their hiding places, and followed up by sauntering doughboys, began the attack.

About this time the enemy got pretty busy with their artillery and the line went out of order. My corporal and I went out to fix it and were gone over two hours. As fast as the line could be repaired in one place it would be broken in another, but by a lot of hard work we finally managed to patch it up. We had secured another reel of wire and soon strung the other side.

The Major had ordered us to stay by his dugout and the second morning of the battle, while he was in the act of passing out some of this instant coffee to the Corporal, a G. I. Can exploded a few yards away. One piece of it found its way into his head and happening to be right there I caught the cup of coffee as he dropped it, and having enjoyed the coffee, helped to carry the poor fellow to an emergency dressing station.

All this time at the front the boys had gained their ground and were easily withstanding the counter-attacks which the Boche were throwing against them. The scrap was a cinch in some ways, for we found out afterward that the Germans had made a relief the night before and they were far from expecting an attack. The line, of course, needed constant attention, and by the time everything was established and our taken ground organised, we had used about eight reels on that one little stretch.

I had a number of narrow escapes, such as a dud falling about two feet from me. That time I was all set to leave this vale of tears, but when it didn't go off it was sure great to feel that I still had another assignment to cover before I was to leave. In all, eight pieces of high explosive found their way into various parts of my clothing and body. My helmet has a very nice hole to demonstrate the force of Germany's mailed fist, while my rifle was fit only for a junk pile after the scrap. All in all, our first contact with German Kultur was pretty exciting, but we made the line work as much as it was humanly possible to do.

(There is one significant item of interest omitted by Bondelid from this story, and that is, that this modest young man was cited by the Divisional Commander for conspicuous gallantry in action.)

Back at headquarters, when the boys went over, the officers waited anxiously for news of the attack. The news came in characteristically American fashion. After 45 minutes of fierce fighting, a voice came over the field telephone, "Hello! this is Cantigny."

And headquarters knew that the Americans, in taking one of the most important towns on the Amiens front, had won their biggest victory to date.

CHAPTER XXXI

NACH PARIS!

MANY Americans will remember the Paris of June, 1918. It was a nervous Paris. A dull, distant rumble by day, and faint flashes on the horizon by night—very much like the flashes of "heat" lightning—furnished a constant and grim reminder that again the Hun was literally at the gate.

And Paris was preparing to pack up and leave. There was a constant exodus of Parisians on every hand, anticipating what seemed the certain doom of their beloved city. Many recalled, only too distinctly, those days of 1871, when Paris fell prey to the selfsame Prussian host.

To add to the sense of impending doom hovering about the city, Gothas dropped their deadly eggs with disconcerting frequency, and Big Bertha, the long range gun, continually spattered huge projectiles into the very midst of the city, with an occasional gravity of damage that was disquieting, to say the least.

At the American telephone headquarters in Paris, however, "business was going on as usual."

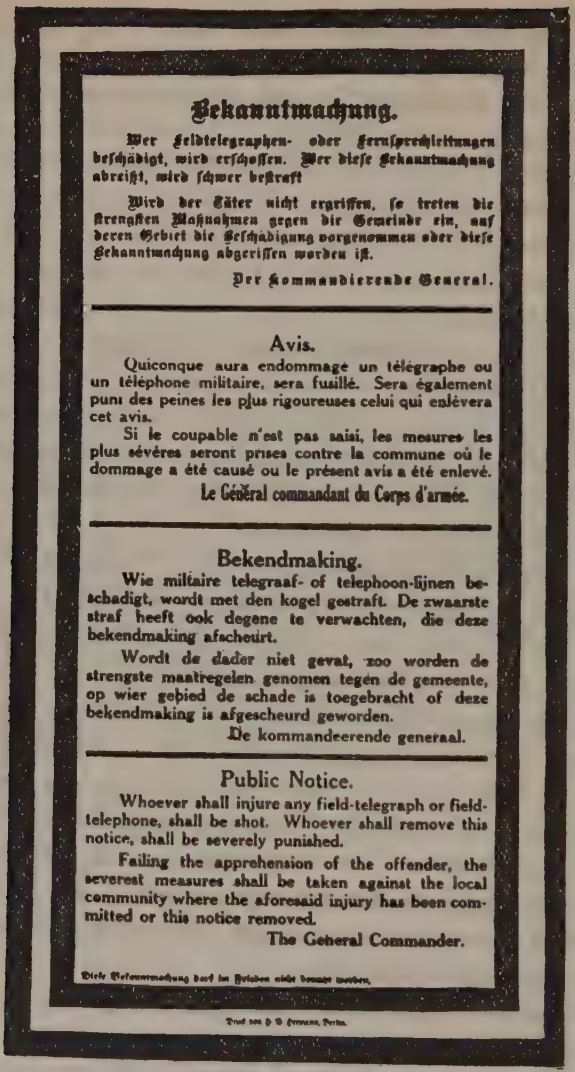
"When the Germans," relates Captain A. L. Hart, of the Wisconsin Telephone Company, in charge of telephone headquarters in Paris, "were sending their regards to the residents of Paris by long-distance pellets from Bertha and tons of dynamite from the air, it became evident that

they had secured a pretty accurate idea of the location of American headquarters. Their time-table for shells was as follows: service started at 7 a. m. and the shells continued to drop at twenty-minute intervals. The shells would explode in the radius of a block or two in either direction from headquarters, at times even closer. Bets were freely made as to the time when a hit would be scored, but when at 12:20 p. m. a shell was placed only 100 feet from the telephone office, the man who had guessed 12 o'clock was declared the winner. Everyone who was fortunate enough to possess a tin hat proceeded to get under it. We erected a temporary barricade of bricks in the windows of the operating room, which was on the ground floor, in order to safeguard the operators on duty from the flying fragments. All bets were decided on this 100′ hit, and nothing closer was scored."

The Paris headquarters of the A. E. F. had instructions to prepare for removal at a moment's notice. The Signal Corps "hello" girls were warned to have their bags packed and to be within calling distance at all times. In the garage adjoining, a number of army trucks were kept in readiness, prepared to whisk these girls away on a moment's notice. However, relates one of the girls, "When it was rumoured that there was a possibility of our having to leave, there was hearty protestation. The telephone business, we felt, had become well-nigh unmanageable on account of the drive going on, and it seemed to us that to put inexperienced boys in our places might prove disastrous."

Headquarters gave them one day more. That, they were told, would be the limit.

In that one day the tide had turned. The girls never left their switchboards.



Bekanntmachung.

Wer Feldtelegraphen- oder Fernsprechleitungen beschädigt, wird erschossen. Wer diese Bekanntmachung abreißt, wird schwer bestraft.

Wird der Täter nicht ergriffen, so treten die strengsten Maßnahmen gegen die Gemeinde ein, auf deren Gebiet die Beschädigung vorgenommen oder diese Bekanntmachung abgerissen worden ist.

Der Kommandierende General.

Avis.

Quiconque aura endommagé un télégraphe ou un téléphone militaire, sera fusillé. Sera également puni des peines les plus rigoureuses celui qui enlévera cet avis.

Si le coupable n'est pas saisi, les mesures les plus sévères seront prises contre la commune où le dommage a été causé ou le présent avis a été enlevé.

Le Général commandant du Corps d'armée.

Bekendmaking.

Wie militaire telegraaf- of telephoon-lijnen beschadigt, wordt met den kogel gestraft. De zwaarste straf heeft ook degene te verwachten, die deze bekendmaking afscheurt.

Wordt de dader niet gevat, zoo worden de strengste maatregelen genomen tegen de gemeente, op wier gebied de schade is toegebracht of deze bekendmaking is afgescheurd geworden.

De kommandeerende generaal.

Public Notice.

Whoever shall injure any field-telegraph or field-telephone, shall be shot. Whoever shall remove this notice, shall be severely punished.

Failing the apprehension of the offender, the severest measures shall be taken against the local community where the aforesaid injury has been committed or this notice removed.

The General Commander.

Diese Bekanntmachung darf im Original nicht benutzt werden.

Druck von J. G. Herrmann, Berlin.

GENTLE DISCIPLINE

Proclamation indicating the importance attached to telephone communication by the German military authorities. Also, incidentally, a reflection of the gentle nature of German discipline.

Suppose Paris had fallen, what would have remained? We recall the dialogue of the returning tourists:

"Have you seen France?"

"I have seen Paris."

"Then you have seen France."

All roads in France lead to Paris. The same is true of the railroads. Any A. E. F. quartermaster sergeant who checked up mileage vouchers could tell you so. Was there ever an A. E. F. officer travelling on a railway from one part of France to another, who didn't "hit" Paris en route?

Well, a somewhat similar situation existed in the matter of telephones.

There are comparatively few former members of the A.E.F. who ever heard of La Belle Epine. There are still fewer who knew that at any time during the summer of 1918, had any of the German air bombs or Big Berthas landed squarely into the midst of American telephone headquarters in Paris —an object the Germans evidently aimed at—telephone communication would have gone on just the same.

This was because of La Belle Epine. The story of La Belle Epine is therefore an interesting one.

It early became evident to the American Signal Corps that unless steps were taken to safeguard electrical communication radiating to and from Paris, or to provide some alternative route of communication, there must always remain a very real menace to the integrity of Allied intercommunication and co-operation. But it took the final German offensive to drive the lesson home.

"Shortly before the Spring of 1918," relates former Major C. O. Bickelhaupt,[1] "I was asked to furnish an estimate on

[1] One of the most efficient and energetic of a coterie of wire experts from the American Telephone and Telegraph Company attached by General Russel to his staff early in the game.

the building of the main telephone line from A. E. F. General Headquarters at Chaumont, half way to British Headquarters at Montreuil, the junction point to be at Compiegne. I made up an estimate covering the kind of material that would be required, the time involved, the availability of the material required, where it was to come from, etc., and this matter was to be immediately taken up and pushed through when General Pershing, or his representative, made his next visit to British General Headquarters, in connection with various joint Anglo-American operations that were to be discussed.

"Within a week from the time when this project was laid out, a large part of the territory through which the line was to be built had fallen into the hands of the Germans in the course of their Spring offensive. Fortunately, nothing had been done on the line, and therefore nothing was lost so far as we were concerned."

As a matter of fact, this experience was in a certain respect a decided gain to us. It was an object lesson. It brought out more clearly than anything else could have done, the extremely shifting character of the territory over which some of our trunk lines had been built and were to be built. It brought home to us the importance of having several strings to our communication bow.

The result was that when the line was finally built, it accomplished the original design of connecting with the British and American General Headquarters, but it was built around Paris, rather than in front of it; which meant that a new station had to be built outside of and to the southwest of Paris, at the point known as La Belle Epine, not far from Versailles. This was put in as a switching station, and all telephone and telegraph lines were strung through there. A



CHATEAU-THIERRY AFTER THE ALLIED ENTRY

On the left is Maltby Stevens, a P. B. X. repairman from The Southern New England Telephone Company, among the first Americans to enter the town.



U. S. Official

ONCE A VILLAGE

The village of Vaux from an airplane: sample of Teuton efficiency



COLONEL WALTER E. BARE

Of the Southern Bell Telephone and Telegraph Company, who commanded the 167th Infantry, Rainbow Division.

cut-off was built around to the south and west of Paris, which connected the entire intercommunication system of the A. E. F. Signal Corps radiating from Paris, and was connected with the British lines to the British G. H. Q. The new station was so equipped that it could do all the switching and temporarily become the Paris office of both telephone and telegraph in case an aerial bombardment or long-distance gun destroyed either the American Central in Paris, or the Paris underground cables.

Two of the Bell Battalions were involved in this special job: the 405th from the Mountain States Group, and the 411th from the Pacific Bell Company.

"On account of my experience in telephone construction work," relates Captain Enoch R. Hannibal, of the 405th Battalion, "I was relieved as supply officer and assigned to Company D, which was sent to Paliseau, a small village near Paris, on a construction job the exact nature of which was not known. It developed upon arrival, however, that we were to build a 24-wire lead from La Belle Epine about 10 kilometres south of Paris, where an exchange was to be established to Versailles to connect with a line being built by the 411th Telegraph Battalion and joining the British line of communication.

"It was right at this time that the enemy was at the door of Paris, and nightly air raids were the rule. Because of this fact, the plan of our line was to skirt Paris and lessen the hazard of a serious break in the lines of communication thereby. The organisation of the company in accordance with the plan of the Signal Corps Drill Regulations was found unsatisfactory for the work we were to do, so we reorganised our sections into typical line construction gangs, and it was here that the ingenuity and resourcefulness of the

men were shown to excellent advantage; for material was difficult to obtain and tools were scarce. Bolts and washers had to be made at times, and in using French material, the quickness with which the men became accustomed to the change from the American standard astonished not only the French, but themselves."

La Belle Epine was one string to General Russel's bow in safeguarding Paris communications. However, the General had another. At Gievres, the great A. E. F. supply centre, the Signal Corps had in reserve a complete duplicate of every bit of telephone and telegraph equipment that would be necessary to refurnish and reinstall a system exactly like that in operation in Paris. It was on Bickelhaupt that the chief burden fell of selecting, from the enormous welter of supply on hand at Gievres, the necessary apparatus to form an exact duplicate of the Paris system.

A complete carbon copy, as it were, of the American wire communication system in Paris, was thus in readiness at Gievres: boxed, crated, labelled and ready to serve. Every item that would have to go into making up an exact working replica of the existing Paris system,—down to oil for the engines and paper for the multiplex printing telegraph machines,—was to be found in its proper filing place, said filing place being a box or crate or some other receptacle, with an envelope attached to it, inside of which was a complete description of the contents, while in separate boxes were to be found specifications telling exactly how and where each item of equipment was to be set up.

Moreover, all this equipment was so arranged that it could be put into service in the shortest possible time. In case the telephone and telegraph central office in Paris, either in whole

or in part, were demolished by air attack or shell fire, this entire telephone plant, or any portion thereof, could have been loaded on cars en route to Paris within two hours.

In the meantime, Paris awaited with keen suspense the outcome of the conflict whose din could clearly be heard barely thirty miles away.

Would the enemy break through? Would Paris fall?

CHAPTER XXXII

PLUGGING THE GAP: CHÂTEAU-THIERRY

News of the Chemins-des-Dames disaster, trickling tenuously through the censor, fell with clammy effect upon the spirits of the folks at home. A chill depression settled upon the land as the full gravity of what had happened began to be understood.

In the meantime Foch, invested with supreme authority over the Allied forces, had begun to size up the situation from the vantage-ground of a generalissimo. The lesson of Cantigny, the brilliant promise held out by the 1st Division in that engagement, had not been lost on the great strategist. And in this critical hour, he turned to the 2nd and 3rd Divisions of the American Army.

The 2nd Division, commanded by General Bundy, was then about to move to Beauvais for further trench training. The 3rd Division, commanded by General Dickman, had not yet had its trench training; had never been under any kind of fire; had not even been together as a unit since it left America. On May 30th, 1918, at 5 A. M., a French officer arrived at 2nd Division Headquarters with orders from Foch to put the whole division on trucks and move with all speed to Meaux. About the same time, another French emissary delivered similar orders to the 3rd Division.

These orders mark a crucial stage in the conduct of the

war. From that time on, until the grand finale of November 11, 1918, there was to be a steady stream of American troops forever headed in the direction of the firing line

Without delay, the 2nd and 3rd Divisions made for the scene of action. Two companies of the 7th Machine Gun Battalion of the 3rd Division, being motorised, got there first. After being more than 24 hours on the road, they went immediately into action, joining the French Colonials in the valiant effort to prevent the Germans from crossing the Marne. Then the rest of the 3rd Division came up, cementing in the gaps in the French defence along the south bank of the river.

Early on the morning of June 1st, the 2nd Division came into a support position behind the French, covering the Paris road at Le Thiolet. On the following day, the French retired upon the Americans, backed through them, and on June 4th, withdrew from the sector entirely, leaving the 2nd Division face to face with the Germans on a 12-mile front before Belleau Wood, Bouresches village and Vaux—to the left and somewhat northwest of Château-Thierry.

The work of the signal troops in this emergency must not be forgotten. The First Field Signal Battalion of the 2nd Division received its orders on May 29th, to be ready to move in two hours. All night long the battalion waited, with everything in readiness. Early in the morning the men began their trip in trucks. They rode all day. The first halt came after midnight, just southwest of the Marne salient, where the men slept in the fields near May-en-Multien. Early next morning the journey was resumed. The roads were a struggling mass of artillery, trucks, cattle and refugees. After a 14-kilometre march, the signalmen started across the fields. At noon of June 1st they reached Montreuil-aux-Lions, which served as Divisional Headquarters of the 2nd Division. As

the signal troops moved up to position, the Frenchmen at the batteries of the 75's insisted that every signalman pull the lanyard and fire a shell at the enemy in Belleau Wood.

"A train wreck", runs the official report of the Chief Signal Officer,[1] "had deprived the signal battalion of its wire carts. Trucks bearing wire and instruments were in the rear of the field train. Nevertheless, by nightfall, connections had been completed from division to regiments, and when the front was shifted that same night to prevent a penetration to the north, the signalmen started again at midnight, completed the new communications, and then worked the whole of the second day repairing breaks.

"One line of twisted pair wire was run from Montreuil-aux-Lions (Headquarters 2nd Division) to Ferme de Paris. Here a telephone exchange was opened to serve as a forward information point, lines being extended therefrom to the Brigade Headquarters on either flank, (the 3rd Brigade, including the 9th and 23rd Infantry, and the 4th Brigade, including the 5th and 6th Marines). The next day a telephone operator at this board, Pvt. First Class Andrew Casey, asked permission to move the switchboard outside the building, which had been hit twice by shells. The board was taken into the open field 100 yards away."

Captain Wm. C. Elmore, of the Wisconsin Telephone Company, was one of the officers who participated in the Marne activities at this time. Elmore went overseas as one of the officers of the 409th Telegraph Battalion, but in May, 1918, was transferred to the 55th Regular Signal Battalion and ordered to field duty at Château-Thierry, taking an active part

[1] Report of the Chief Signal Officer to the Secretary of War, 1919, p. 395.

in the fight on June 1st. He gives us an interesting picture of the scene of action:

I saw some of the horrors of war when unloading refugees. I witnessed one old man caring for six little tots, not knowing who any of them were. An old couple carried their all tied up in a bandana handkerchief: family clock, marriage certificate and some money. These people came in on flat cars, and had no place to go. The 410th Telegraph Battalion (Chicago and Wisconsin Bell) took care of them.

At the first battle of Château-Thierry, I was told that the road was blocked with supply trains, but I must manage to string out three circuits "until I met the Germans." There my instructions ended. It was not just clear to me what I should do when I met them—that would depend largely on the Germans. The Major said: "God bless you, my boy, I hope you get back." We strung out our lines until we came to a river. It was pitch dark, and I called back for further instructions. "Stay there," came the command. Whether the stay would be an hour, a day, or a week was not mentioned. Troops were reported to the right, but who they were, I did not know for some time. They might, for all I know, be German troops. Fortunately, they turned out to be the good old Seventh Infantry, U. S. Regulars.

In No Man's Land I was arrested for a German spy by a French patrol, and was marched some distance just one inch ahead of a bayonet into the presence of a number of headquarters gentlemen before my identity could be established.

I want to commend the spirit of our boys. While on observation duty, a shell dropped very near to the car from which I had just alighted. After the explosion I saw my chauffeur lying over the wheel unconscious, with a bad cut on his head. I lifted him from the machine and applied "first aid" remedies, and when the boy sat up, his first words were, "Thank God, Captain, they didn't get you!" It's no trick to lead men like that.

Later, Elmore relates, "the sergeant who accompanied me was killed, and when they found me they say I was sitting on the ground repairing the telephone wires and alternating between Sunday School and army language. I cannot verify this, as my thinker was not working very clearly at the time."

In the meantime, certain elements of the infantry of the 3rd Division, which had followed up the first two companies of the 7th Machine Gun Battalion, were aiding the French in their unsuccessful effort to hold Hill 204 north of the Marne. The 3rd Division then went into line south of the river facing Chateau-Thierry, and extending as far east as the mouth of the little Surmelin stream which comes down from the south.

Corporal Arthur W. Bergman, from the office of the Auditor of Disbursements, of the Chicago Telephone Company, whose career in the war might be entitled "From Bookkeeping to Bridge Building at Château-Thierry," tells of his experience in constructing bridges across the Marne as the lines swayed back and forth in this neighbourhood. For about twelve nights Bergman, with his eight men, carried pontoon lumber from motor trucks back of the lines up through the shell torn quarter-mile to where the bridges were being feverishly put together.

"It was not so much fun", Bergman admits, "to stand waist deep in the water and build bridges under shell and machine gun fire. And we didn't laugh, either, when we would see one which we had just finished, blown to pieces by a big shell. We always worked at night; and when the star shells flared—well, we dropped in a hurry. By reason of our losses by fire and gas we received replacements every night. Before long, all the men in the company were strangers."

And then, beginning on the 4th of June, the Marine Brigade of the 2nd Division, deciding to move forward, began to carve their name into history in the famous battle of Belleau Wood, which has probably been described more than almost any other American engagement. Against obstacles seemingly insurmountable, against a veritable hail of lead, through

open wheat fields and densely wooded country, the Marine Brigade of the 2nd Division worked its way forward, suffering fearful casualties, but irresistible in its onward movement. By the end of the month, Belleau Wood and Bouresches village had been cleared of the enemy.

Throughout the entire engagement, all regiments were connected to Division Headquarters by wire. To say this, is to give no indication whatsoever of the heroism and sacrifice involved. On June 15th, the Brigade Commander of the 6th Marines directed that a Signal Corps officer be sent to his headquarters. Lieutenant Earle W. Arnold, anticipating trouble, responded. He had a vague feeling that he was being called on the carpet for something he might have overlooked in the desperate rush of things. But the call-down he received from the Brigade Commander was somewhat as follows: "Lieutenant, I just wanted some signal officer to whom I could unburden this message: During all my years of experience, I have never seen such devotion to duty on the part of enlisted men, as that displayed by the signal corps detail at Domptin!"

At the station of the regimental radio section of the outpost platoon with the 6th Marines, a message was being transmitted to Division Headquarters one morning, when a shell came through the window and landed upon the table. It is no mean commentary on the agility of these signalmen that, although the station was completely demolished, the men had dived through the window to safety before the shell could explode.

The wire company of this Field Signal Battalion lost its first man on June 14th, in Private First Class Carpenter, an operator at Brigade headquarters at Domptin. Carpenter was to go on duty at midnight of June 13th. He started for

the dugout while the town was under bombardment, when a shell burst at his feet.

Months later a bereaved parent, witnessing a screen representation entitled "Whispering Wires of War", surprised the audience about him by starting up and uttering the cry, "My son!"

We will let the Bell Telephone News, of Milwaukee, Wisconsin, tell the rest of the story:

Of all the thousands of people who have seen the film "Whispering Wires of War," it is safe to say that there is probably no one who has had the unique experience or felt the deep personal appeal that came to J. O. Carpenter, of Ridgeville, Ind., when he saw upon the screen his own son who eleven months before was killed in action in France.

"Whispering Wires of War" was made by Pathé in collaboration with the American Telephone and Telegraph Company, and shows vividly the important part that the telephone and telegraph men and women played in the great war.

Some time ago the film manufacturers received a letter from Mr. Carpenter, in which he said: "I am anxious to know if it is possible to secure a copy of the film, 'Whispering Wires of War.' The section of this film that shows the importance of keeping the wires in repair, shows my son who was later killed in this work. The film shows him plainly and I sure would like to have it."

Mr. Carpenter's request was referred to J. A. Leggett, of the Eastern Industrial Division of the Pathé organisation, who immediately wrote to Mr. Carpenter assuring him that a print of the section of the film would be made and forwarded to him with the compliments of the manufacturers.

Not only the section of the film, but also enlargements were recently sent to Mr. Carpenter, who, in his letter of acknowledgment expressing the gratitude of himself and his family, enclosed a copy of a letter from his late son's bunkie. It was written in Germany on Mother's Day, eleven months after young Carpenter's death, to Mrs. Carpenter, and gives a picture of the work of the Signal Corps. In his letter Sergeant Van Blarcom, writing from the headquarters of the 1st Field Signal Battalion at Neunied, said:

On the night of June 14-15, 1918, the enemy made a supreme effort to retake Belleau Wood, and dropped a terrific artillery barrage over our lines. The town, Domptin, which we were in, was caught in the barrage. Signal Corps lines were torn down by bursting shells—and they must be repaired. Our quarters were across the street from the telephone booth. John and I were at the quarters and knew that we must be needed at telephone headquarters to repair the damage caused by the barrage. It was decided that we run the gauntlet one at a time. I went first and made the booth in safety. I waited for five minutes in the doorway, but your son did not put in his appearance. When I had decided that he was not coming a shell burst in the road, lighting everything up, and for one brief second I caught sight of John being flung high into the air by the bursting of the shell. I called to him and asked if he were badly hurt—his answer was, "Stay where you are, I can make it." I waited awhile and called again; he answered very weakly that he was coming—and still he didn't come. I called to Sergeant Allen (who was later severely gassed and now blind from the effects of it) and he and I went out and carried John to the dugout. He was very severely wounded about the head, legs and body, but was apparently in no great pain as he strived to laugh and joke with us. Private Haggerty of the Medical Department of this Battalion dressed his wounds and gave him a pain-killing anæsthetic, and an ambulance was summoned. By the time the ambulance could get through John was sleeping and seemed to be resting quite comfortably. He was removed to the hospital but never regained consciousness.

As the Marine Brigade of the 2nd Division was finishing up its heroic task at Belleau Wood, the Infantry Brigade of the same Division (the 3rd Brigade, composed of the 9th and 23rd Infantry Regiments,) by a swift, forward movement begun at dusk of June 30th, took the village of Vaux and 500 prisoners.

The First Army Corps, which had been organised months before, but whose administrative continuity had been interrupted by the series of German offensives, had, during this period, begun to function. On June 17th, corps headquar-

ters was moved into the Château-Thierry sector, and the corps took over the administrative control of the 2nd and 3rd Divisions. By the end of the month the 28th Division had come into the corps. The Vaux offensive was under the direction of the corps.

On June 19th, therefore, our old friends of the 406th Telegraph Battalion (Pennsylvania Bell) had moved to La Ferte-sous-Jouarre. The 406th, it will be remembered, had been assigned as the First Army Corps Telegraph Battalion. By the end of the month, the 406th had installed a new telephone and telegraph system for corps headquarters, with three camp switchboards, 57 telephones and a 5-position telegraph office; also a lighting system consisting of a 5-kilowat generator and certain lines laid for the divisions.

Additional expert assistance was requisitioned from Paris, and Captain A. L. Hart, of the Wisconsin Telephone Company, in charge of the Paris telephone exchange, was ordered to report to the signal officer of the French Army, to work in conjunction with that officer in establishing telephone and telegraph stations for the First Army Corps at La Ferte, Milon, and also at Chateau-Thierry, Trillport and Meaux.

"There were nine of us," says Hart, "billeted in hay stacks and barns during those trying days in which the Germans were advancing toward Paris. We encountered large numbers of German prisoners being escorted to the rear of the French lines. We secured meals when we could and as best we could with the French troops stationed in the vicinity, as the Americans had not at that time taken up their definite positions."

This was shortly before the 9th and 23rd Regiments succeeded in taking Vaux with a military dash and punctilio that must have been nothing short of amazing to the German

veterans ensconced in that village. And here again the truth was evident, that if you would feel the pulse of an attack, you must sit beside the officer at the telephone in a post of command. For that is what Thomas Johnson, New York *Evening Sun* correspondent, did, and he tells the story of Vaux in this way:

The clock showed one minute to six. Sixty seconds later the Colonel said: "We are operating against Vaux and La Roche Wood now." Minutes passed before the first message came. The Colonel repeated it, "Very little machine fire. Cows are milking fine."

"Field artillery laying a good barrage," interpreted an artillery officer.

The telephone bell rang again. "German barrage commencing. Not very heavy. Our counter-barrage seems to be good." The clock showed 6:20. "In ten minutes our infantry will have all their objectives," said the Colonel. Then came the first evidence of how the thing went. "Rockets seen at La Roche Wood." That was the infantry signalling to our airplanes. The telephone bell tinkled once more. The message was from brigade headquarters. "Line cut by shell fire. Men working on it under fire. Hope to have it fixed in five minutes." The Colonel hung up the receiver. "Good Lord!" he said, "I've got to sit here and wait. Is there anything more helpless than a Colonel?"

But the wait was not long. Two minutes later the telephone rang and the news made the Colonel jump. It was from the Major who led the attack. "We've got all our objectives and the first lot of prisoners is being sent in." The Colonel started relaying the news along the new front line. "Tell the boys I'm proud of them. Tell 'em to keep on digging till they get to China. There'll be counter-attacks coming and we've got to get consolidated."

Another report. "200 prisoners, all very discouraged. Say others will surrender if we'll let them." The Colonel called to his artillery officer. "Let's rake in some of those prisoners. I want a rolling barrage that will roll backward. Start it about 300 yards beyond our objective and bring it back slowly to about 100 yards of our new front line. That'll bring 'em in."

And then a messenger arrived. "I saw 'em go over," he said. "There's nothing to it. Easy pickin's."

"Good! What's your name?" responded the Colonel. "Conners, sir." "Well, well, he's Irish, too," said the Colonel in delight. He rose and stretched. "This has been a good day for the regiment," he remarked. "Let's go up and take a look at the prisoners."

Another story, related by the Stars and Stripes, concerns an attack which obviously refers to the taking of Vaux.

Six infantrymen—a corporal and five privates, who after it was all over, disappeared into the anonymity whence they came—and Signal Sergeant Clifton G. Gosch are the principal characters in the story.

Sergeant Gosch, detailed by the major of an attacking battalion to put a telephone in a town about to be taken by the Americans, obtained the detail of the six infantrymen to assist him. When the battalion to which this detail was attached charged and entered the town, the sergeant and his detail followed closely, laying their wires and finally installing the telephone in the cellar of a three-story building only slightly damaged by shell fire. No sooner was the phone connected up, than Gosch called up regimental headquarters to test it. It tested O. K. Gosch then went out to report the completion of his task to the major. He walked down the street, rounded a corner, dodged a couple of shells, and ran into an American detachment who informed him that Fritz was counter-attacking, and the order was to withdraw temporarily. He withdrew. Then, just as he had gained the security of the American line, he bethought himself of his detail crowded back there in the cellar.

He went to the P. C., and rang the bell of his new phone. There came a prompt answer from the corporal.

"What division is holding your town?" asked the sergeant.

"The ——— Americans", said the corporal.

"Like hell they are," said Sergeant Gosch, breaking it gently, "the ——— German division is holding the town."

There was a gasp from the corporal, and then a long pause. The corporal had gone up to have a look.

"That's right," finally came the reply, "the street is full of Boches."

"You sit tight," advised the sergeant. "We're going to attack again this afternoon—and stay in the cellar, because we're going to put over a barrage."

The barrage, in preparation for the American second attack, came in due time. In the midst of it, the telephone in the regimental P. C. buzzed. It was the isolated post in the German-held town. The corporal was speaking.

"Say," he said, "this barrage ain't killing as many Germans as it might."

The colonel got on the phone.

"I'll connect you with the artillery and you tell them where to shoot," he ordered.

The connection was made, and from then on the squad of doughboys directed the American artillery fire in all the area within sight of the top of the building they were in. They formed a line from the roof, and relayed the directions down to the cellar, where the information was repeated over the telephone. Buildings upon which the Germans had placed machine guns were showered with shells and destroyed, barricades in the streets were deluged with shrapnel, and a battery of field pieces firing from the far edge of the town was silenced.

And then the doughboys came up and retook the town.

One more incident in relation to the taking of Vaux,

recorded by the Chief Signal Officer in his official report,[1] furnishes an eloquent commentary on the conversion of the Melting Pot into the War Cauldron:

When the leading company of the 9th Regiment made a turning movement, the signalmen preceded the infantry into Vaux. The man with the 12-drop switchboard, who was seeking a place for installation, found a large dugout, but it was occupied by nine Germans. They objected to his plan to install the board there. He insisted. A battle royal began. One of the enemy made an exclamation in Polish. The signalman, Polish by birth, answered in the same language. Then the call of blood triumphed. Five Poles joined the American and he soon emerged with a broken switchboard and nine prisoners.

[1] Report of the Chief Signal Officer to the Secretary of War, 1919, pp. 396 to 397.

CHAPTER XXXIII

THE DELUGE IS DAMMED

The crisis was over; but the deluge had by no means ceased to roll forward. That seemingly inexhaustible tide of field gray was to rise yet twice again, in the final effort to burst and overwhelm the Allied dike.

The worth of American troops, first demonstrated at Cantigny, was now conclusively established. But the lesson was not for Foch alone, for Ludendorff saw it as well. The problem was now clearly crystallised: for Ludendorff, how to effect a speedy and decisive conclusion of hostilities by a last supreme effort before the Americans came up in still greater force; for Foch, how to move the largest number of Americans, trained or untrained, into the line against the foe.

Ludendorff's wedge, moreover, now threatened to take the shape of a boomerang. The Marne salient had become dangerously narrow between Soissons and Rheims. The road to Paris via Château-Thierry blocked, Ludendorff's problem now was to widen the salient by spreading forward the sides of his triangle and widen the angle at the Château-Thierry tip. Hence the Noyon-Montdidier offensive of June 9th-15th on the western side of the triangle, followed, on July 15th-18th, by the last German stroke on the eastern side of the triangle from Château-Thierry to Rheims, along the Champagne-Marne valley.

The Noyon-Montdidier offensive had already occurred by the time the Marine and Infantry Brigades of the 2nd Division had taken Belleau Wood and Vaux respectively. By June 15th it was evident that Ludendorff had failed to accomplish his object: the western side of the triangle held fast.

Before Ludendorff could try the other side of the triangle, the British, on whose sector the German pressure had necessarily lightened, determined to carry out a counter-offensive of their own. In the neighbourhood of Hamel a considerable force of Australians, with the aid of scattered American contingents, helped the latter to celebrate the Fourth of July by rushing forward, on that day, and boldly wresting the town of Hamel from the Prussian grasp.

It was in connection with the taking of Hamel that Sergeant Andrew J. Erhardt, an employee in the Commercial Department of the Central Bell Group, Chicago, rendered service not prescribed in Army Regulations, but which resulted, nevertheless, in his being decorated by the King of England for conspicuous bravery. In the immediate sector where Sergeant Erhardt was stationed, a nest of German machine guns blocked the way. Determined to get rid of them, Erhardt crossed an open, shell-swept field, and clamoured for admission to one of the tanks operating in conjunction with American troops at the other end of the field. Erhardt was admitted, directed the tank to the machine gun nest, and the tank did the rest.

While the Australians were taking Hamel, Ludendorff was preparing his Campagne-Marne thrust. Gouraud, to whom Foch had entrusted the immediate task of warding off the blow, had secured advance information as to Ludendorff's plans. This gave him the exact day, hour and minute set for the attack. Consequently he set about, with deadly de-

liberateness, preparing his men and his artillery to rob the German offensive of the effect of surprise and, when the time came, to bash in the heavily massed attackers with a punishment that was to put a final quietus on German offensive morale.

And in preparing his defence, Gouraud availed himself to the utmost of existing American strength.

Ten days before the offensive came off, the 26th or Yankee Division had relieved the 2nd Division at Belleau Wood, Bouresches and Vaur. On July 10th, the 42nd or Rainbow Division became part—and a very important part—of Gouraud's plan of defence.

It was a surprise to the 42nd. Several weeks before, this Division, after a sustained period of strenuous fighting, had been down in the comparatively peaceful Lorraine sector, awaiting a much needed rest. When, on June 19th, the Rainbow Division had received orders to leave the trenches, it was with every expectation on the part of the men that they were due for a quiet interval of relief. By June 21st the Rainbow Division was out of the trenches, headed, as they thought, toward a haven of repose. On the morning of their departure from the Baccarat sector, a beautiful rainbow appeared directly ahead of them. It was decidedly a rainbow of promise, for all its blood-red: the Division it symbolised was to render a service in the damming of the final German deluge worthy of the noblest traditions of the American Army.

The Rainbow Division was relieved by the 77th Division, composed of National Army men from New York. The 77th were comparatively recent arrivals in the A. E. F., and this occupation of the Lorraine trenches was a new experience to them.

George J. Leinfelder, of the American Telephone and Telegraph Company, relates the following:

It was down in Lorraine that my company had its first real test. I was with the 77th Division at that time and we were to relieve the 42nd. So twenty-four hours previous to the company's going in, the officers, including myself, went up and made a personal reconnaissance of the sector. It was a beautiful spot, and we, being machine gunners, were detailed to hold the woods. The centre of these woods had been thinned, and had rustic walks and a few rustic summer houses. Birds could be heard singing, and even a rabbit ran across our path. In fact it looked so peaceful that when we returned the captain told some of the men that it looked like an Irish picnic ground. One of the Irishmen in the company said, "That may be so, Captain, but did you ever see an Irish picnic wind up?"

That Irishman was a prophet. The Germans knew that a relief was soon to be made, for on the day previous, one of their planes flew over, dropping a lot of cards on which was printed, "Good-bye, 42nd; welcome, 77th." A few days later, on June 24th, the show started. The curtain rose at 2:30 a. m. Fritz began with a short and violent barrage, and during the performance, which lasted three hours, he used everything from liquid fire to gas.

Besides the 26th and 42nd Divisions, there were also, as part of General Gouraud's plan of defence, the 4th Division, to the left of the 26th, the 3rd Division, between the 26th and 42nd, and, in back of the 3rd Division, the 28th or Pennsylvania National Guard Division, acting as a support division, and coming up later into valiant action at Dormans. The 1st and 2nd Divisions, during the conflict, approached Soissons from the west.

The grand Prussian attack came off on July 15th, as per schedule. It was met by a withering burst of fire little short of annihilating. And it was here that the Rainbow Division, going under fire—to quote Babin, the French historian—"as

if to a football game, in shirt sleeves rolled up over sinewy biceps," so brilliantly distinguished themselves, along with their comrades from the other American divisions, as to earn the unstinted praise of that taciturn old French soldier, Gouraud.

Colonel Walter E. Bare, who before the war was Division Superintendent of the Gadsten Division of the Southern Bell Telephone and Telegraph Company, and who, upon his return, became Acting District Manager of that company, at Montgomery, Alabama, commanded the 167th Infantry Regiment of the Rainbow Division. Of himself, Colonel Bare has little to say, but he cannot say too much of his regiment. Colonel Bare writes:

Trained and rendered ruggedly confident the 167th Infantry began its career as a shock regiment in the grand defensive battle against the Germans in the Champagne on July 15, 1918. In this, its first major action, the regiment took a splendid part in the bloody repulse inflicted by General Gouraud's IV Army upon the great German offensive and earned the official and personal commendation of the French Government. It was at this point that Company F held a very important position in what was known as the Hinterland, with orders to remain at its post at all costs. With Company E on the right and supported by the regimental machine gun company, these elements of the regiment absolutely held the enemy within their lines, inflicting heavy losses on them. The German casualties on the front of 25 kilometres were reported as 88,000, while the Allied casualties in this same sector were comparatively light.

The 167th Infantry proudly asserts that it has spent more days in the face of the enemy, gained more ground against the enemy, and marched farther in its operations than any other regiment in the American Expeditionary Force. It has been opposed by the best divisions of the German army, and it has made its record at their expense. The regiment was the first American unit to capture prisoners unaided by the French, and these prisoners were captured by members of F Company of Gadsden, Ala. A member of the regiment was the first soldier to receive the Con-

gressional Medal of Honor awarded in the A. E. F. for exceptional bravery on the field of battle.

The record of the 167th Infantry was in no small part due to the efficiency and example of its commander. Colonel Bare was the officer who personally carried that now famous order which sent his regiment over the top at La Croix Rouge Farm, where it gained so much glory and lost so heavily. The order had arrived late at the post of command, and the attack of the Alabamians would have been delayed, with possibly fatal results to the rest of the line, had it been delivered in the usual manner. Colonel Bare, not deigning to send a subordinate through the terrible field of fire, jumped on a motorcycle, rode over a shell-swept road, and when stopped by fallen trees went forward on foot. He reached the two battalions then in line at La Croix Rouge Farm, and at 4:25 delivered the order for the great attack which was to begin five minutes later, at 4:30, on the morning of July 26th. Two days afterward, the Colonel was wounded. The Colonel's personal conduct, the fact that he received two citations from the Commander-in-Chief of the A. E. F., and was recommended for the Distinguished Service Cross and Distinguished Medal, explain in no small part the record made by his regiment.

Many are the deeds of bravery enacted during these few days, the telling of which could not but bring a sense of justifiable pride to any American; but to record them all would require an endless series of volumes. There is space for but one or two episodes, which are characteristic of the rest rather than exceptions to the rule.

Somewhere between Château-Thierry and Fossoy was the supporting artillery of Company B, 8th Machine Gun Battalion. In front of the battalion, but on the other side of the

Marne River, lay a town occupied by German troops. It was an unknown quantity to the Americans, who contemplated an advance in which the taking of that town was to figure.

So it happened that Company B was ordered to advance across the river and establish telephone communication on the other side. Company B had been under fire for some time, and had no officers at the time, all of them being either killed, wounded, or lost in the battered territory in which the fight was being waged. In charge of the company was First Sergeant Theodore H. Willers, a former telephone installer-repairman in the Plant Department at Ithaca, of the New York Telephone Company, Central Division.

Sergeant Willers decided that the task of establishing communication with the American artillery and the other side of the Marne was one that he himself should undertake. Accordingly, on the night of July 18th, he swam the Marne, accompanied by Master Signal Electrician Ferguson, to whom he acted as guard. Ferguson carried a Western Electric set weighing about fifteen pounds. He, also, by the way, was an old telephone man who was connected with the Bell System out in the Middle West.

Paying the line out as they went, the two men finally reached the opposite bank, and established communication with the battery. Details of what was taking place in the town were reported, and soon shells began to drop here and there, driving the soldiers from their cover.

In the meantime the other members of Company B approached on the right flank, and Company A closed in on the left, surrounding the town and mowing down the Germans by their devastating machine gun fire.

These brave machine-gunners took the town, but were driven out when the Germans recovered from their amazement.

Nothing daunted, they advanced again, and again they were victorious. Once more they lost it, but by a final drive secured it again, and held it.

To these American machine-gunners, the idea of starting something, and not finishing it, was unthinkable. And that was the idea of the rest of that young, irresistible host that succeeded in sweeping the Germans back from the Marne.

July 15, 1918, has been called the worst single day the Germans ever had. Certainly their offensive crumpled up as utterly as any offensive in history. It was the last of Ludendorff's final series of desperate drives. The Germans never attacked again. Gone was their offensive—forever lost. The deluge was definitely dammed.

CHAPTER XXXIV

MULTIPLYING THE MESSAGE

As the drama progresses on the World War stage, episode following episode in rapid succession—Cantigny, Château-Thierry, Noyon-Montdidier, Champagne-Marne—the forces behind the scenes, easily lost sight of precisely because they are behind the scenes, are none the less strenuously in motion to provide those conditions without which the play out in front could not possibly proceed.

It is a period of stupendous A. E. F. growth. Lloyd George's prior appeal for ships, ships and more ships is now echoed in Foch's appeal for troops, troops and more troops. Trained or untrained, *numbers* sum up, in a word, Foch's need of the hour.

But added to numbers is the speed element. It is the old race against time, more pronounced than ever.

Therefore, these hundreds of thousands of troops now arriving monthly fresh from America must be put through the mill in the quickest possible time, must be rushed to the front with the least amount of preliminary. And all this necessarily means the utmost speeding up of the machinery all along the line, from the mobilisation, training and embarkation centres back home, to the base ports in the A. E. F., and from the base ports by the quickest possible jumps through the intermediate steps to the front line.

It is impossible to convey an adequate picture of the unparalleled augmentation in size and velocity that marked this crucial period in the history of the A. E. F. Official statistical curves graphically portraying the situation all shoot upward at this particular period of development. And, naturally, none of these "upward shoots" is more characteristically shown than that for telephone and telegraph traffic.

What this killing pace necessarily meant to the Signal Corps wire system, can scarcely be imagined. For consider: The neck of A. E. F. progress was at its communication end. The faster and wider the A. E. F. mushroomed out, the greater grew the need of intercommunication. If this important part of the realm behind the scenes fell down, the whole play out in front collapsed.

Mere figures convey but the feeblest indication of the actual growth in signal wire facilities which took place during this period. The total number of telegrams handled by the A. E. F. Signal Corps in October, 1917, was barely over 13,000. By February, 1918, it had reached over 162,000 for the month. During the next month this traffic jumped nearly 60,000 messages, or 35 per cent. By August, 1918, the number of telegraph messages handled monthly by the A. E. F. Signal Corps had reached the total of 885,000, an increase of nearly 450 per cent over the number that had been handled during the month preceding the opening of the German Spring drives.

And so with the telephone. On January 1, 1918, the telephone plant of the Signal Corps in operation consisted of less than a dozen and a half offices, connected by 33 circuits. By the end of June, 1918, the central office equipment, leaping out of all proportion to expectations at the first of the

year, had grown to a system of 94 switchboards in operation, totaling upwards of 3600 stations, besides which many of the earlier switchboards had been tremendously enlarged to handle the flood of traffic that came pouring in from all sides upon the Signal Corps telephone organisation.

All this necessarily meant adequate provision by energetic new construction, and it was here that General Russel's policy of being several jumps ahead of requirements in his signal facilities shone through.

As General Russel explained, in an address delivered before the New York Telephone Society, February 25, 1920:

> The establishment of the business headquarters of the Services of Supply at Tours in March, 1918, saw the American pole line from Chaumont to Tours completed and its extension by April to St. Nazaire. By July the great branch from Bourges to Bordeaux was finished. In August an American ten-wire line replaced the wires leased from the French between Paris and Chaumont. In September a ten-wire line likewise replaced the French wires between Paris and Tours. North of Chaumont sturdy constructors were rushing our 20-wire "Berlin line," as we called it, through Joinville and Bar-le-Duc to the First Army headquarters at Souilly, following the tremendous activities developing in our final offensive.
>
> Meanwhile, extensive wire networks were growing in every direction north and east of Neufchâteau, and around each of the great depot centres, ports, training areas and schools. As we approached the front, the lines frequently reached headquarters in semi-permanent form with light poles, cross-arms and small bronze wire. This construction with 8, 16 and 24 wires became a familiar roadside feature in all the combat areas.
>
> In this strenuous period the skill and devotion to duty of our telegraph and field battalions became most appreciated. It was *work* during every hour that daylight permitted them to see their lines. The character of line construction was of the highest class. It was realised by all that future reliability was most essential, and that proper maintenance of poor lines would be a hopeless task. High class switchboard and toll test men worked

cheerfully at the roughest line construction or served as cooks. To take care of the specialists' jobs, and at the same time provide maintenance parties, required selection and distribution of men from our limited resources with greatest care.

By July, 1918, the growth of the system was so phenomenal that a forecast had to be made to take care of the needs of an army of 4,000,000 men in prospect by July, 1919. The Signal Corps was fortunate in having the chief engineer of the great A. T. & T. systems, Colonel John J. Carty, the world's leading telephone engineer, to aid in laying out a system which included long aerial cable lines to replace the wire lines that would by that time be entirely inadequate. That a gigantic extension would clearly be necessary was shown by Colonel Carty's study of our traffic data, and the solution of the problem was well under way when the armistice came.

Our organisations of special installers, that we dubbed our Signal Corps "shock troops," when thrown into a village where army or corps headquarters had been suddenly decided upon, could, by working day and night, have a complete telephone and telegraph system in full working order in an amazingly short time; and this with the switchboard and other wiring laid out neatly, not in provisional or "rats' nest" condition.[1] This method of grouping specialists and sending them with equipment fitted to carry out these large emergency jobs relieved the combat signal organisations from work for which their light mobile equipment did not specially fit them, and at the same time enabled these installations to be made in accordance with approved telephone engineering plans that insured employment of the best apparatus and contributed in no small degree to uniformity and continuity of our electrical communications.

And it was here also that General Russel's first decision, made back in New York during that memorable conference in Colonel Carty's office, justified itself more clearly than ever: the decision "to go the whole hog" in the matter of telephone and telegraph communication, including all the modern

[1] This refers in particular to "Lowden's Gang." Captain John G. Lowden, of the New York Telephone Company, had organised a crew of picked telephone men from various Bell organisations whose capacity for installing entire telephone systems on short notice was a never-ending source of wonder to army commanders in the field.

devices of up-to-date telegraphy and telephony, with a full use of the *simplex, composite, duplex* and *multiplex.*

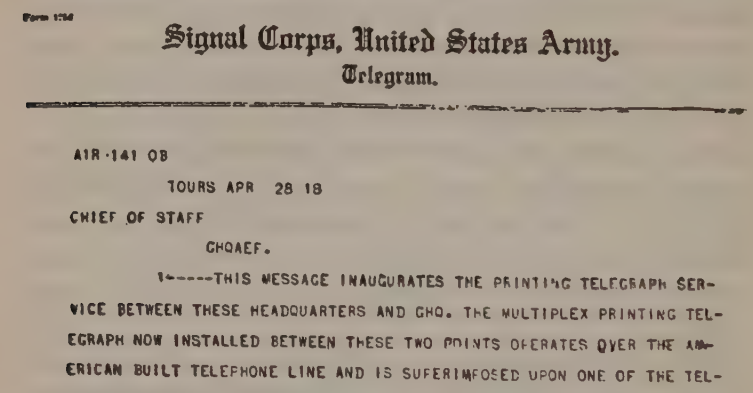
In the task of successfully resisting Ludendorff's final onslaught and enabling Foch to develop his plan for a counter-offensive, multiplex telegraphy and highly specialised telephony played this part: Foch's plans rested on a whirlwind expansion of the American Army at the front. This whirlwind expansion of the American Army could not have been managed but for a corresponding expansion of the A. E. F. structure. The latter would have been impossible but for a correspondingly adequate capacity of the Signal Corps to handle the resulting burst of wire traffic; and this, in turn, would have been out of the question but for the extraordinary capacity of Russel's American system of multiplex telegraphy and modern telephony to "eat up" traffic in emergency.

This American system included, it will be recalled, the *simplex,* or a combination of one grounded telegraph circuit with one metallic telephone circuit; the *composite,* a device to get two grounded telegraph circuits from one metallic telephone circuit; the *duplex,* a means for taking either of the above *simplexes* or *composites* and arranging it so that two messages can be sent simultaneously over each of these derived telegraph circuits—one message in each direction; the *multiplex,* a device whereby the ends of the above *duplexes* are rotated in exact synchronism between two or more printing telegraph machines, resulting in an unbelievably voracious capacity for handling telegraph traffic; and, finally the *phantom,* an extra telephone circuit obtained by utilising two existing metallic circuits in such a way as to obtain a third circuit, without any additional line wires.

As an example of what was possible by these methods in

the matter of extraordinary saving in time and new construction, may be cited the following:

Take as a unit four wires. These wires could be used jointly for telephone and telegraph purposes. For telephone purposes, each of these four-wire groups could be made to furnish three telephone circuits: two *physical* circuits of



Form 1756

Signal Corps, United States Army.

Telegram.

AIR-141 OB

TOURS APR 28 18

CHIEF OF STAFF

GHQAEF.

1----THIS MESSAGE INAUGURATES THE PRINTING TELEGRAPH SERVICE BETWEEN THESE HEADQUARTERS AND GHQ. THE MULTIPLEX PRINTING TELEGRAPH NOW INSTALLED BETWEEN THESE TWO POINTS OPERATES OVER THE AMERICAN BUILT TELEPHONE LINE AND IS SUPERIMPOSED UPON ONE OF THE TELEPHONE CIRCUITS. IT IS NOW ARRANGED FOR SENDING TWO MESSAGES IN EACH DIRECTION SIMULTANEOUSLY OVER THE ONE CIRCUIT AND WHEN NECESSITY REQUIRES IT CAN BE EXPANDED TO SEND FOUR MESSAGES IN EACH DIRECTION OVER ONE LINE CIRCUIT AND THIS CIRCUIT CAN AT THE SAME TIME BE USED IN THE TELEPHONE SERVICE. THE MULTIPLEX PRINTING TELEGRAPH WILL OPERATE UP TO 50 WORDS PER MINUTE OVER EACH CHANNEL; THEREFORE THIS CIRCUIT AS NOW INSTALLED WILL SEND 200 WORDS PER MINUTE OVER THE LINE WIRE

1----THIS APPARATUS WAS INSTALLED BY OFFICERS AND MEN OF THE SIGNAL CORPS.

RUSSEL

FIRST PRINTING TELEGRAPH MESSAGE OF THE U. S. SIGNAL CORPS IN FRANCE

two wires each, and one *phantom* circuit derived from the two physical circuits. For the telegraph, each of these self-same groups could be *composited,* furnishing four telegraph circuits; and each of these wires was also *duplexed,* doubling

the four telegraph circuits to eight; and by the use of the printing telegraph, on a "triple-duplex-multiplex" basis, it was possible to multiply each of these eight messages by three, and thus yield twenty-four telegraph messages.

And so, from the original four wires, it was possible to build up a total of three telephone messages and twenty-four telegraph messages, all of which could be carried over the four wires at one and the same time.

The corresponding saving in time and effort can readily be imagined.

"The first multiplex equipment," relates Fay, "arrived in France late in March, 1918, and the first sets were installed and placed in operation on April 28th, 1918."

This was fully a month before the 2nd and 3rd Divisions were called upon to stop the Hun at the Marne, following their break-through on the Chemin-des-Dames.

So fertile, indeed, was this remarkable use of the multiplex printer on a triple-duplex basis, that the single cable of four conductors operated across the English Channel by the A. E. F. Signal Corps provided a total of 18 channels of telegraphic communication between the A. E. F. in France and the A. E. F. in England, with a possibility of increasing these to 24 channels. These channels of communication ran as follows (arbitrary numbers assigned):

Conductor No. 1, London to Brest, Navy, Morse Duplex	2 Channels
Conductor No. 2, London to Tours, Army, Double Duplex Printer	4 Channels
Conductor No. 3, London to Chaumont, Army, Triple Duplex Printer	6 Channels
Conductor No. 4, London to Paris, Army, Triple Duplex Printer	6 Channels
Making a total of	18 Channels

It was intended to convert all the above to triple duplex printer service, which would give six channels for each conductor, or 24 in all. The Armistice, however, intervened, and this was not necessary.

At no time did the Signal Corps have to worry lest the telegraph traffic should catch up to telegraph facilities, as the margin of unused facilities was at all times reassuringly ample.

It is doubtful whether the importance of this trans-channel system of communication from the A. E. F. in France to the A. E. F. in England, has been fully appreciated. The exceedingly vital ports of debarkation at Liverpool, Southampton, Belfast, Swansea and Folkestone, the multiplicity of American air service activities in England, the motor transport corps centres, engineer depots, hospitals and training centres were such as to form an essential part of the fabric of A. E. F. activity in France, upon which, indeed, the entire success of the American army in France rested.

Not only, therefore, were A. E. F. communication facilities between France and England exceedingly important, but the communication facilities within the A. E. F. in England were equally important. These facilities are briefly described by Arthur A. May, formerly Commercial Manager for the Nebraska Telephone Company at Gothenburg, Nebraska, who, during the war, was the officer in charge of the Signal Corps telephone system throughout England:

"We had a good-sized working system in operation which, at the biggest point of extension, consisted of 14 exchanges, three of them in London itself; also about 600 miles of leased long lines. This system stretched from Liverpool on the north to Portsmouth on the south, with a circuit to Paris thrown in. We had about 30 British girl operators, and a right loyal crew they were, too.



SIGNAL CORPS TELEGRAPH OFFICE AT TOURS, FRANCE



U. S. Official

MULTIPLEX (PRINTING TELEGRAPH) SECTION

U. S. Signal Corps Telegraph Office Headquarters at Tours, France



THE AMERICAN INVASION

Nothing was more typical of the American Invasion than the characteristic American type of telephone construction.



Left: a corner pole erected by telephone men in France. Right: a unique telephone pole, pressed into service under the spur of necessity.

It was quite a task, though, to teach them to talk American instead of English."

And May recites, with pride pardonable in a former resident of Gothenburg, Nebraska, that he was presented to King George V, at Buckingham Palace, and "had a chance to shake the old boy by the hand."

There was one additional feature of the original decision reached in Colonel Carty's office which played an important part in meeting the extraordinary traffic emergency precipitated by Ludendorff's drives, and that was the telephone *repeater,*—already described, it will be remembered, as a mechanism one foot square and about seven feet high, which regenerates the telephone conversation. The *repeater* consists principally of an electric valve, in appearance very much resembling an incandescent bulb, through which the current flows in such a way that every wave formation in it—meaning, for the present purpose, the human voice—is amplified and reproduced with absolute fidelity and carried along the line. It is this quality which is responsible for the wonderful improvement in telephone transmission at long distances on circuits equipped with *repeaters.*

The use of telephone *repeaters* greatly simplified the construction and maintenance problem of the A. E. F. Signal Corps, for without the service of the telephone *repeater,* a wire of much larger size would have been required, thereby involving an enormously increased tonnage, and a pole line of strength impracticable to obtain from the pole stocks of Europe.

"It can be said," reports the Chief Signal Officer,[1] "that the talking efficiency of the long distance plant of the Ameri-

[1] Report of the Chief Signal Officer to the Secretary of War, 1919, p. 204.

can Expeditionary Forces was due almost entirely to the use of the vacuum-tube telephone repeater."

The first telephone *repeaters* were placed in service on May 15, 1918, at Autun, on the Chaumont-Paris line. The next *repeater* installation was made at Paris, also in May, and then in June, the third installation was made at the British General Headquarters at Montreuil, serving also for our communication between Tours, Chaumont and London, as well as for British service to London.

This latter installation took place while the Noyon-Montdidier offensive was at its height. W. M. Marsters, one of the young experts from the American Telephone and Telegraph Company provided by Colonel Carty, personally installed the large majority of the A. E. F. *repeaters.* He tells with unfeigned glee of his trip to British General Headquarters at Montreuil to install a *repeater* at that point in connection with the Paris-London circuit. Marsters was then a corporal. He was later commissioned.

We piled the telephone *repeater* into a Dodge truck and left Paris at 5 o'clock in the afternoon of June 5th. That evening I went to bed on the *repeater,* literally sleeping on it all night, and the next day we got busy on the installation. By 4:30 in the afternoon the *repeater* was in operation on the line from Paris to London.

You ought to have seen the British officers watching that installation. I always had an idea, from what little observation I have had, that a British officer was just about as warm and friendly as a lobster on ice. Well, don't you believe it. On this occasion I was absolutely bombarded with questions about the *repeater* from a group of interested British officers; what it would do, how it worked, etc., etc., and they showed a lively interest in the proceedings. And you ought to have seen the British non-coms. stand about with their mouths wide open, gasping for breath, as they watched these staid British officers passing out cigarette after cigarette to "that bloomin' American corp'ral"

with the "phoney gear," and, horror of horrors, insisting on *lighting* each cigarette—for an American corp'ral!

In all, a total of 12 telephone repeaters were installed, as follows: Autun, Paris, Montreuil, Bordeaux, Tour, La Belle Epine, Limoges, St. Nazaire, Chaumont, Souilly, Briey and Turin, Italy.

The installations at Briey, and at Turin, Italy, will furnish, later on, incidents unique in themselves.

CHAPTER XXXV

SAFEGUARDING THE MESSAGE

When the business of the advance section around Neufchâteau became so important that a signal officer had to be appointed for this area, Major Kelly, a huge, big hearted, big fisted gentleman, measuring six feet from head to toe and six inches across the point of his chin, was selected to fill the post.

According to Gallo, of the 406th (Pennsylvania Bell) Telegraph Battalion, who was serving as telephone operator in the Langres office, Major Kelly happened one evening to overhear certain light conversation from the Y. M. C. A. telephone. He tried to find out who had been talking, but the "Y" man was unable to tell him. He turned to Gallo, who was working at the frame.

"Who put that telephone in at the 'Y'?"

"The 117th Field Battalion, sir," replied Gallo.

"Very well, as soon as you are through here, go down and *yank that telephone out!*"

When Gallo arrived at the "Y" and explained his mission, the worker, after much pleading, requested that he be allowed to speak to Major Kelly. The connection established, the following conversation ensued:

"This is Senator So-and-So, and I am a friend of Senator _____"

"Well," came the interruption, "this is Major Kelly, and I am a friend of Uncle Sam, *so out goes your telephone!*"

That ended the conversation.

The friend of Senator So-and-So probably believes to this day that Major Kelly's act was a glaring instance of high-handed autocracy in the American Army. Yet Kelly was acting under strict orders inspired no less by the pressing need of conserving telephone talk than of safeguarding it against enemy appropriation.

"Orders are orders"; and the rule was inexorably carried out all along the line, where the general order to husband all telephone talk embraced the strictest rules governing code names and the use of camouflaged language over the telephone.

One day Major Nels Anderson (Southwestern Bell,) a Field Artillery officer, was arranging for a telephone communication with an observation balloon. The observer was to note the effect of firing on a point invisible from the ground. "After spending about two hours getting a connection through the various exchanges," relates Major Anderson, "we got the observer on the line. There was some question in the observer's mind as to the batteries that were to fire, so he asked the officer at the battery where he was located. The officer started to give the real name of the organisation when blooey! went the connection, as one of the vigilant operators on the line carried out instructions to rip out any connection over which secret information of this sort was passing."

Many a conversation at the front, unknown to the immediate parties at the time, was to be followed by swift retribution. The silent American watchers of wire talk would copy it all down, including the profanity, and send it in to

headquarters, where it served a purpose not confined to the mere education and amusement of the General Staff. Before long, there was comparative quiet on our side of the line, except for absolutely essential messages.

Many telephone men in the United States will recall that a sudden shortage developed during the Summer of 1918, in the supply of what is commonly known as "twisted pair." It was not clearly understood at the time why it was that the United States Government commandeered all the available supply of this particular wire in the States, but it was clear at once that it would result in an enormous handicap to the Bell Telephone System in the maintenance of its service,—a handicap that was to be felt for years to come, inasmuch as "twisted pair" formed a vital part of telephone construction and installation. The "Plant Department" of the Chicago Telephone Company, for example, was using this wire in Chicago alone, at the rate of 300,000 feet per month.

There is a story in back of it all.

At the outset of our participation in the war, no such thing as "twisted pair" was known at the front. The Allies knew nothing of it; neither did the enemy; neither, apparently, did we, so far as its special usefulness at the front was concerned.

For a field wire to connect stations at the front, a form of outpost wire was being used, over which a telegraph or telephone message could be sent on a "grounded" or single-conductor basis. But so simple was it for the German listening posts to "listen-in" on these lines by picking up leaks through the earth, that conversations carried on over this form of wire might just as well have been carried on over a wire leading direct to Berlin. It was clear that a new form of outpost wire would be necessary: a wire light enough

to permit of easy portability and rapid laying, strong enough to stand the strain of heavy traffic and the rip and tear of front line conditions, but above all, so well insulated that leaks to the ground would be minimized, if not absolutely eliminated.

The outpost wire originally used by the American Signal Corps, following Allied practice, was wretched in the extreme. It was brittle, it was weak, it was flimsy,—it was so bad that most of it was junked by the American Signal Corps Supply Headquarters, who simply did not dare to send such stuff out to the front, where its failure in emergency might well lead to disaster. Indeed, so wretched was one kind of this outpost wire, that it was dubbed "Sunshine Wire," because the insulation was so bad that it wouldn't work when it rained.

The Bell System was then using, as drop wiring to connect houses to telephone lines in country and suburban districts, a standard copper-clad steel "twisted pair" wire, the insulation of which was exceedingly tough. The wire itself was of comparatively small size—not so small, however, as the outpost wire then being used at the front. And it was very strong. One could drive a truck over it without damaging it in the least.

One day one of the Bell men attached to the Signal Corps got an inspiration. "What's the matter," he said, "with Mother Bell's good old twisted pair?"

There was nothing the matter with it, as a trial at the front soon demonstrated.

And so "twisted pair" came to the rescue. It was being manufactured for the Bell System in huge quantities. The Government promptly commandeered all the available supply in the United States, as well as the total output from

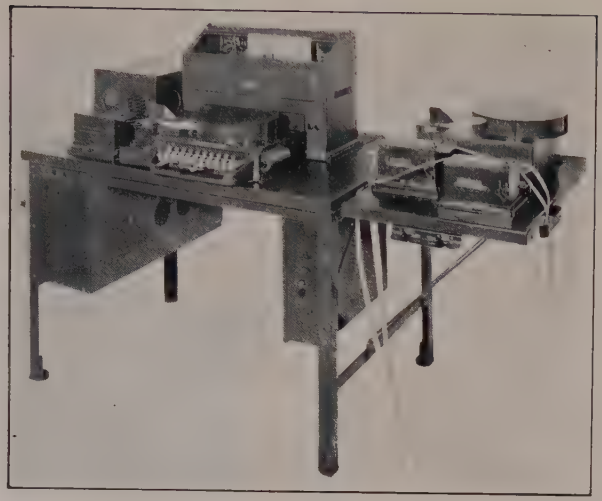
the factories; and before long, enormous quantities of it were being diverted to the fighting front.

It did the trick. It fulfilled the main objects for which it was designed: rapidity of loose line construction, and a satisfactorily diminished hazard of eavesdropping by the enemy. As finally modified for Signal Corps use, it resembled in size and appearance the cord used for incandescent lamps, and consisted of seven fine wires, four of them bronze and three of them of red carbon steel, stranded together and coated first with rubber and then with cotton yarn and finally with paraffin. The wire was produced in six colours, red, yellow, green, brown, black and grey, in order that it might be readily identified in the field; the red wire running, for example, to the artillery, the yellow to regimental headquarters, green to brigade headquarters, etc.

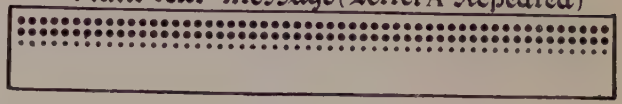
The enormous amount of this wire required may be seen from the estimate of the Signal Corps that it would need 68,000 miles of outpost wire a month. Very little of it was saved. It was out of the question to pick it up during the hurry and excitement of an advance, and hundreds of miles of it were destroyed during the heavy bombardment which usually preceded the attack.

All this, necessarily, affected the service back home; a sacrifice, needless to say, which was cheerfully made both by the public and the telephone companies serving them.

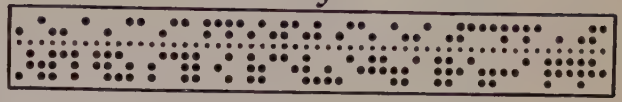
Not that the latter simply resigned themselves to the situation, for they immediately took steps to provide substitutes by scraping the country for every available foot of old wire capable of passing a physical examination before the ever watchful eyes of the telephone engineers. One company succeeded in rescuing 900,000 feet of old wire from the toils of a junkman, and by a careful and thorough salvaging,



Plain Text Message (Letter A Repeated)



Key

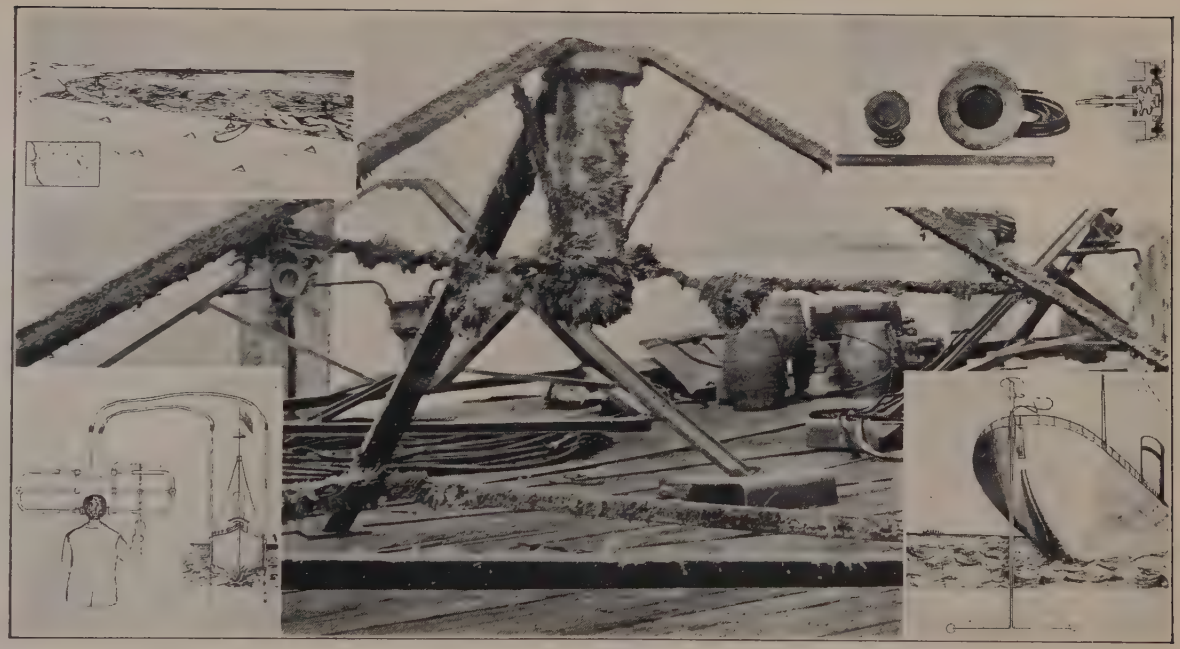


Message in Cipher



THE CIPHER MACHINE

Designed by engineers of the American Telephone and Telegraph Company. The first absolutely undecipherable code in the history of the human race. Cuts to the right show perforated tape used in transmitting message.



SUBMARINE DETECTION

Body of Picture: Seaphone Tripod. These devices, connected with land stations by cables, were planted on the ocean floor, each equipped with a detector-transmitter to pick up the sound of a submarine propeller. Detector-transmitter, showing design, etc., in upper right insert. Upper Left: Cross section sketch, showing coast defense system with tripods planted, shore station, and submarine submerged. Lower Left: Schematic drawing showing method of locating underwater craft. Lower Right: The "C" Tube: an underseas "ear periscope."

every foot of that wire fit for service was promptly put to work. Moreover, the General Engineering Department of the American Telephone and Telegraph Company immediately set to work on the task of devising substitutes for these wires, and before long, specifications and instructions covering the use of these substitutes were in the hands of every Bell Telephone engineering department in the United States.

There remained, however, the necessity of protecting against the "enemy in our midst"—against that perfectly organised, fiendishly efficient system of subterranean warfare carried on by agents of the Kaiser prowling noiselessly in the highways and byways of our national life at home. And one of the most vital points at which we were exposed to these activities was, naturally, the telephone.

So the first problem was, how to patrol and safeguard from enemy tapping, something like twenty-two million miles of telephone wire and over two million miles of telegraph wire.

This was one of the fundamental matters covered in the early conferences between War Department and Bell Company officials, and when war was declared, prompt measures were taken in line with plans previously worked out.

Watchmen and guards were selected from among the male employees of the telephone company, and were placed at all exchanges as protection against any interference on the part of those unfriendly to the country's cause. Employees with automobiles were relieved from their regular duties and assigned to this work and the work of patrolling important toll lines and main underground cables carrying wires connecting these lines to the toll central office equipment in all important cities. This was continued until the danger from interference had passed. In addition, periodical inspections were made by specially picked men, to make sure that no

unauthorised or illegal attachments were being made by wire tappers on lines used by the Government.

The most interesting phase of this work is the one that cannot be published. It is only too well known to many former subjects of the Kaiser.

One story, however, can now be told, and that relates to the "cipher machine." Jules Verne himself could have conceived in imagination no more wonderful contrivance than was here conceived, not in imagination, but in fact.

It became apparent at the very outset that a complete defence against interception of messages by enemy agents would be impossible. The best that could be done would be to minimise its effect. And this, of course, is aimed at in code or cipher systems of message transmission.

Now the trouble with a code or cipher message is, that it is code only so long as its meaning to outsiders remains undiscovered. And to army experts whose entire lifetime is devoted to the framing and dissecting of codes, the interval between the creation of a code and its interpretation by outsiders is usually not a very long one.

It has been the dream of Army and Navy code experts the world over, almost from the very first time a cipher system was invented, that one might be devised which would absolutely baffle analysis. Years of marvellous ingenuity vainly expended on this effort finally produced the conviction among the best informed experts that, while a code system might be devised which would nonplus outsiders for a considerable period, ultimately the key must be discovered; for what the human mind has created, the human mind can recreate.

During the World War, therefore, and up to the entry of America into this struggle, the idea of an absolutely un-

decipherable code was generally regarded as more or less illusory.

And yet there was the usual modicum of Yankee venturesomeness that refused to accept anything in the realm of the mechanical as impossible. A veritable host of schemes came pouring in upon the Signal Corps, each absolutely guaranteed to prevent listening-in by enemy spies. And one after another they fell before the rigid test of the Signal Corps code experts.

One inventor came forward with a device which, although it would not render a message undecipherable, would make it impossible, he claimed, for an enemy agent to tap the wires over which messages were being sent, without the sender and receiver being instantly aware of it. The Signal Corps asked to be shown. It provided the inventor with an opportunity to demonstrate. The demonstration took place. Without the slightest difficulty, the military experts tapped the line and, with the aid of a stenographer, recorded every shred of the message sent over. So minute was the quantity of energy withdrawn by the Signal Corps experts in tapping the line, that the delicate detectors devised by this inventor failed to give the slightest indication that the line had been tampered with.

Another scheme was based on the principle of breaking up the Morse dots and dashes representing the letters of a message, and routing these disjointed fragments over widely scattered wires to the receiving station, where they were automatically joined together again so as to form the message as originally sent. For example, if it were desired to send from Hoboken to Washington the message, "Transport Leviathan sails June 25th," the idea was to make use of two telegraph circuits, one running say from Hoboken to

Washington, via Harrisburg, and the other via Wilmington. The message sent via Harrisburg would be broken up something as follows: "t-a-s-o-t-e-i-t-a-s-i-s-u-e-w-n-y-i-t," while the portion going by way of Wilmington would read: "r-n-p-r-l-v-a-h-n-a-l-j-n-t-e-t-f-f-h."

This was an exceedingly ingenious system, but by no means impenetrable to the intelligence of the shrewd German spies.

Numerous other ingenious devices were invented for frustrating the machinations of enemy spies, but not one of these could, with any degree of assurance, be called an absolutely undecipherable device.

It was at about this time that Colonel Carty, at the recommendation of General Russel, from the other side, strongly supported by General Pershing, was assigned by General Squier to the task of safeguarding from enemy interference that vast transatlantic electrical link upon whose vital strands depended the continued existence not only of the A. E. F., but of the entire Allied effort,—resting, as it now did, upon continuous and interrupted American food supply and transport. It was in connection with that, and the menace not only of cable tapping, but of cable cutting by enemy submarines, that Colonel Carty, early in 1918, entrusted the problem of devising an absolutely undecipherable code to a number of brilliant minds in the Engineering Department of the American Telephone and Telegraph Company and the Western Electric Company.

It was the old story. The solution lay directly in the path of the simple and the obvious. It was so simple and so obvious, that it had almost escaped notice.

The American Telephone and Telegraph Company had for some time been using the printing telegraph machine;

the device, previously described, for sending telegraph messages mechanically, instead of through operators. The essential feature of this contrivance is the elimination of manual labour in the course of transmitting the message. At one end of the line the operator types off the message on a typewriter, and at the other end the message appears again in typewritten form; but otherwise, throughout the entire course of transmission, the operation is entirely automatic.

A day or two after the matter of an undeciperable code was referred to the American Telephone and Telegraph Company for solution, one of the engineers of this organisation—an ingenious young man named G. S. Vernam—got a "hunch." The "hunch" was followed by a brief period of intensive study, and the result was a mechanical device which, as finally developed, proved nothing short of uncanny in its almost human-like functioning.

It was the device that code experts had dreamed of; for it was capable of transmitting in plain English, messages absolutely undecipherable en route. And it represents, to this day, the only undecipherable code device known to man: a triumph of Yankee ingenuity. It will transform an ordinary message into cipher, transmit it with absolute secrecy, and decode it at the other end—all at the rate of from 40 to 70 words a minute.

In ease of operation, it is simplicity itself. The message is first written in plain English in the originating office, copied on a typewriter keyboard, then automatically enciphered into a baffling combination of perforations on a long paper tape. The tape is passed through a transmitter and thus sent over the wire to the distant end, where it reappears in the form of a similarly perforated tape, is forwarded to its desination, and there run through a deciphering machine

from which it comes out in plain English as originally written!

The system uses a "running cipher key" of great length, consisting of a succession of characters, preferably selected at random. The fundamental idea is to combine each character of the original message with a character of the key and produce a third character which represents in cipher the original character, or in the reverse operation to combine each character of the enciphered message with a character of the key to produce the original.

The ciphered messages appearing on this machine may be in the form of perforated tapes or printed on message blanks, and may be transmitted over an ordinary telegraph or radio system, or may be placed in the mail, or carried by courier—it makes no difference, so far as safety against enemy interception is concerned. The enemy, should he intercept the message, could spend the rest of his days upon this earth in a vain effort to decipher it, for without the decoding machine, the effort would be doomed to failure.

The cipher key is either in the form of a perforated tape of great length, or in the form of two continuous tapes of different lengths, which "step" together through automatic transmitters and produce "cipher key" combinations. Thus, one tape might be 1000 characters or "steps" in length, and the other 999 characters or steps; and if rolled or "stepped" together, the total number of possible combinations resulting would be the product of the two lengths, or 999,000 code combinations, before the key system would start to repeat itself. An ordinary printer tape containing this number of combinations would be over a mile and a half in length. By the use of this cipher machine and two tapes, the length is cut down to eight feet for each of the tapes.

As if this marvel of ingenuity were not enough, the ingenious Mr. Vernam has even worked out a code for use in connection with the cipher printing machine, which will automatically translate from one language into another. For example, the author has himself seen this young man feed into the encoding end of the device, the query, "Can you speak French?" which came out at the other end, "Parlez vous Francais?"

(The author hesitated long before deciding to report this; not to safeguard its secrecy—for it is still secret, in spite of what has been said—but to safeguard the author's reputation for veracity. He would not have believed it himself had he not seen it.)

Mention has already been made of Colonel Carty's efforts to assist in maintaining a constant uninterrupted flow of communication across the Atlantic. When it is remembered that the American army fought more than 3000 miles from its home base, and that the tremendous stream of men and supplies from the United States to the distant firing line depended largely upon a few slender threads of electrical communication to the directive centre at Washington, the gravity of this problem will be appreciated. It was a line of communication that, following our entry into the war, was at no time safe from either enemy tapping or cable cutting, and the efforts to safeguard the vital link of communication are of such special interest that they deserve to be detailed in a separate chapter.

CHAPTER XXXVI

THE TRANS-ATLANTIC ELECTRICAL LINK

Multiply the Lost Battalion a thousand fold, and you have a situation somewhat remotely approaching that which would have occurred had the American army in France been suddenly severed from its home base in the United States by a rupture of that slender thread of electrical communications from which the A. E. F. was suspended at a distance of over 3000 miles from Washington.

It was a matter of no small concern to General Pershing and his Chief Signal Officer. It was, indeed, one of the vital matters discussed in that famous conference of wire experts which took place in New York, at Colonel Carty's office, on the day before General Russel sailed overseas. Thoughtfully and thoroughly, the reliability of cable communication between the United States and Europe was gone into from every possible angle.

Before the World War, 17 transatlantic cables between Europe and North America were in operation. At the beginning of the war, two German cables via the Azores were cut. By 1917, six more cables had developed deep-sea faults which, owing to submarine activities, were impossible to repair.

This left but 9 cables to carry the gigantic but precious burden of cable intercommunication between those two widely scattered hosts battling the then triumphant enemy.

As a result of the conference in New York, the sobering conclusion was reached that complete severance of cable conclusion by the enemy was by no means impossible. General Pershing was going across to build up an overseas army whose telegraphic communication with the home base might be completely cut off!

That these experts had warrant for their fears, will appear from subsequent events.

Several months later Russel, who had become a member of the Inter-Allied Radio Conference, which held frequent sittings in Paris, presented the question of possible cable cutting by enemy submarines, and the serious consequences that would follow a total interruption of cable traffic.

"We must provide some means," Russel urged, "of increasing facilities for transatlantic communication. Radio seems to indicate the direction."

It was a menace which had received all too little attention. Some members of the Conference were inclined to pooh-pooh the danger. But all finally admitted the desirability of increasing existing facilities.

Accordingly, on August 23, 1917, Russel brought the matter up before Pershing for definite action. He wrote:

> There is no question of the grave situation in which we may find ourselves as a result of extensive cable cutting, which, in the belief of all of the cable authorities I have consulted, may be easily effected by the enemy. The enormous importance of immediate provision of reliable and extensive transatlantic radiotelegraphic service is therefore evident. The naval attaché informs me that he is taking up the matter through naval headquarters, and the earnest and immediate co-operation of all concerned is urged in this important matter.

General Pershing immediately forwarded this communication to Washington with the following endorsement:

1. The importance of securing reliable auxiliary service by transatlantic radiotelegraphy is evident. The need for such a dependable telegraphic service increases with the growth of the American forces in Europe.
2. Immediate co-operation with the French and English Governments to secure extension of transatlantic radiotelegraphic service is urged.

"Upon receipt of these communications," records the official report,[1] "the Chief Signal Officer of the Army directed Colonel John J. Carty, Signal Corps, to prepare plans and to take the necessary steps to secure at all hazards, the continuity of telegraphic communication with the American Expeditionary Forces in Europe, and to call upon him for whatever funds, personnel, and equipment that might be required. As a result of an immediate survey which he made, Colonel Carty reported that the quickest results could be obtained by utilising the high-power radio stations on the Atlantic seaboard, which were being operated by the Navy, in conjunction with the high-power radio stations in Great Britain and Ireland, and in France and Italy, employing also, if necessary, any high-power stations which might be found suitable in Canada. Immediate arrangements were made accordingly for co-operation with the Navy."

Colonel Carty had already made preliminary investigation on this subject. He now proceeded to organise the investigation upon the basis of a special detail representing the Signal Corps, to co-operate with the Navy, the former including Lieutenant-Colonels F. B. Jewett and N. H. Slaughter of the Western Electric Company, and Lieutenant-Colonel J. O. Mauborgne, of whom mention has been previously made.

With this work under way, the Chief Signal Officer of

[1] Report of the Chief Signal Officer to the Secretary of War, 1919, p. 134.

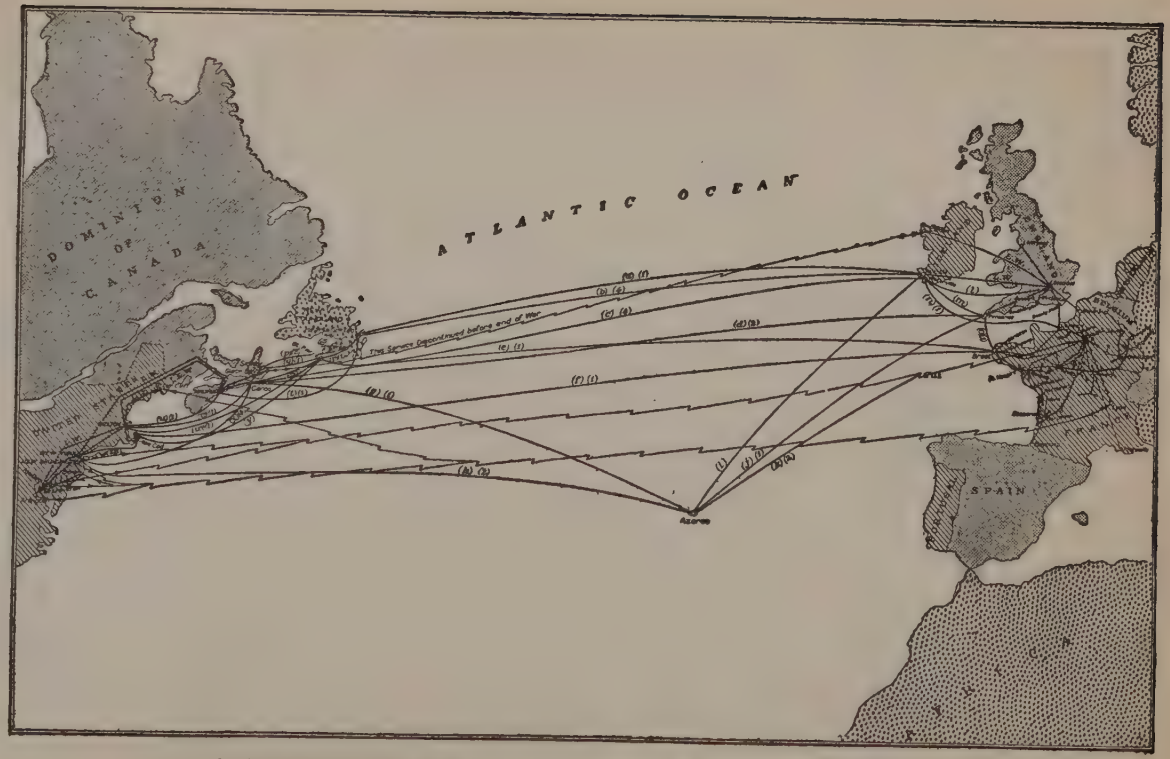
the United States Army hastened to assure the Chief Signal Officer of the A. E. F. by cable that the matter was in hand:

> Your letters August 23rd and 29th relative radiotelegraph communication and inclosed proceedings of Interallied Commission: This office fully realises gravity of situation. Energetic steps have been inaugurated in conjunction with Navy to co-operate to fullest extent in this programme. Colonel Carty is in charge of these arrangements on behalf of Signal Corps. Please inform General Pershing and French authorities. Will report progress frequently.

Then, on October 4, 1917, on board the U. S. S. *Chicago* at New London, Conn., there was held a grand conference of Army and Navy experts, at which the whole subject of transatlantic electrical communication was thoroughly threshed out upon the basis of the most exhaustive studies which had preceded the conference. The Army was represented by Colonel John J. Carty and Lieutenant-Colonel Nugent H. Slaughter; the Navy by Captains D. W. Todd, S. S. Robinson, and A. J. Hopburn, and Lieutenant-Commanders S. C. Hooper and G. C. Sweet. The French Army, too, was represented by Lieutenant M. Paternot.

At this conference, Carty submitted his recommendations, based upon previous conferences and study with Jewett and Slaughter, of the Western Electric, and Yorke, of the Western Union, to the effect that the Signal Corps and U. S. Navy arrange for a co-operative development of high-power transatlantic radio stations, and the straightening of already existing ones; these stations being operated, for the most part, by the Navy Department.

The recommendations were approved and in due course, the findings of the conference were forwarded to General Russel, representing the United States Army on the Interallied Commission sitting in France. The New London



TRANSATLANTIC ELECTRICAL COMMUNICATION DURING THE WORLD WAR
(For explanation, see facing page.)

(Explanation of Chart on Opposite Page.)

Chart showing trans-atlantic electrical channels of communication between the United States and her European Allies during the World War. These facilities are designated in accordance with the following code:

Solid black line indicates marine telegraph cables, land wires in the United States, and main long distance telephone (also telegraph) lines in France built and operated by the United States Signal Corps.

Solid light line (in France) indicates main long distance telephone lines (also telegraph) operated by the United States Signal Corps.

Zigzag lines across the Atlantic indicate main radio channels employed during the War. The direction of the arrows indicates whether the respective stations were used for sending, receiving, or both.

Wavy line between Paris and Lyons indicates telegraph channel used as auxiliary to radio communication at these points.

Figures inside of circles designate the number of channels employed per cable.

Letters indicate company or organization owning or controlling the respective cables, as follows: (a) Direct United States Cable Company; (b) Anglo-American Tel. Company; (c) Commercial Cable Company; (d) Western Union Telegraph Company; (e) Compagnie Francaise des Cables Telegraphiques; (f) Compagnie Francaise des Cables Telegraphiques; (g) Commercial Cable Company; (h) Deutsch Atlantische Telegraphen Gesellschaft; (i) The Commercial Cable Company; (j) Eastern Telegraph Company; (k) Deutsch Atlantische Telegraphen Gesellschaft; (l) Commercial Cable Company (Waterville, Ireland to London, England); (m) Waterville, Ireland to Penzance, England; (n) Waterville, Ireland to LeHavre, France; (o) Compagnie Francaise des Cables Telegraphiques (Penzance, England to Brest, France); (p) Anglo-American Cable Company (Sidney, Canada to Placentia, N. F.); (q) Anglo-American Cable Company (Sidney to St. Pierre); (r) Anglo-American Cable Company (St. Pierre to Placentia, N. F.); (s) Compagnie Francaise des Cables Telegraphiques (Canso, N. S., to St. Pierre); (t) Direct United States Cable Company (Halifax to Heart's Content, N. F.); (u) Direct United States Cable Company (Boston to Halifax); (v) Commercial Cable Company (Boston to Canso, N. S.); (w) Anglo-American Cable Company (Boston to St. Pierre); (x) (2) Commercial Cable Company, (2) Western Union Telegraph Company (New York to Canso, N. S.); (y) Compagnie Francaise des Cables Telegraphiques (Cape Cod to St. Pierre); (z) Compagnie Francaise des Cables Telegraphiques (New York to Cape Cod); (L. W.) Land Wires.

Conference urged "that every effort be made to secure an nearly as possible continuous transmitting from France to America during the entire 24 hours of the day, so that emergency messages could be handled in any case. To this end it is suggested that at least one very powerful station be installed in France."

The erection of this high-power station was subsequently decided upon under an agreement with the French whereby the latter were to provide the site for the station, and the United States Navy was to erect the towers and install the necessary apparatus, all of which would be supplied from America.

Immediately thereafter, work began in earnest on the mapping out of a comprehensive programme which would apply all possible resources to the problem in hand. We will let the Chief Signal Officer of the U. S. Army tell his own story: [1]

The studies which were conducted and the experiments and tests which were made in the United States were numerous, and many of them highly scientific in character. In general, the problem consisted, first, in providing radio stations of sufficiently high power to secure the best attainable signals even under favorable conditions; second, in finding measures to insure continuity of radio service at times of serious static disturbances; and third, to devise plans whereby, in the event of intentional interference on the part of the enemy, the radio signals might not be confused or obliterated by arbitrary signals transmitted for the purpose from high-power enemy stations.

To meet the first condition the Navy Department undertook to complete, as rapidly as possible, a new high-power station at Annapolis, Md., and to rapidly increase to the fullest extent practicable the power of all of the existing transatlantic stations. In addition to this, the Navy designed and undertook the erection of a high-power station at Croix d'Hins, near Bordeaux, in France, which was the station recommended by the New London confer-

[1] From the Report of the Chief Signal Officer to the Secretary of War, 1919, pp. 135 ff.

ence and which was intended to be the most powerful station which had yet been constructed.[1]

To meet the second condition, tests were made by the Navy at various naval radio stations on the Atlantic coast to determine those locations in which the least static disturbances were likely to prevail. Corresponding investigations were made on an extensive scale by the Signal Corps,[2] which sent numerous expeditions to different parts of the United States to make electrical and meteorological observations; to determine the intensity of static disturbances and their relation to meteorological conditions; the degree of intensity of signals received; and to get all other scientific data obtainable, which might bear upon the problem.

To meet the third condition, intentional interference, numerous scientific methods were tested and studied at the Navy stations and elsewhere.

As a result a comprehensive plan was adopted whereby, in case of necessity, receiving stations at Newfoundland in the north, and along the Atlantic coast of the United States and elsewhere, and throughout the United States as far west even as the Pacific, might be employed. As many of such stations as would be required would be connected by wire with Washington, so that the chances of a large number of widely separated stations being simultaneously interfered with by static or otherwise would be minimised. Each of these stations would be equipped to receive the same transatlantic radio messages, and each telegraph the message by wire to Washington. By this plan the missing parts of a message which could not be received at one station, could be supplied from one or more of the other stations out of the zone of interference. The details of other features of the plan are many of them very scientific in character, voluminous in amount, and are still regarded as confidential.

And then comes another phase of the transatlantic communication situation, revealing only too clearly that the fears entertained by Russel and Carty at their first conference in New York, were by no means fanciful. The Chief Signal Officer's account continues:

[1] This station, it might be added, upon its completion in 1920 actually was the most powerful radio station in the world.

[2] Chiefly conducted under the direction of Nugent H. Slaughter, of the Western Electric Company.

Word was received from the Navy Department early in May, 1918, that the enemy was employing submarine vessels to cut cables, and that certain local European cables had already been cut, presumably by this means. In the following June it was reported by the Navy as coming from sources believed to be reliable that the Central Powers were making preparations to cut all cables on the American coast by specially constructed submarines, and that it was also planned to destroy simultaneously all high-power American wireless stations. If this scheme were unsuccessful, it was reported that the enemy planned to make communication difficult by international interference by German high-power radio stations. Upon receipt of this information a conference was held by Colonel Carty at the office of the Director of Naval Communications at Washington, at which were present Captain D. W. Todd, the Director; Major C. C. Culver, of the Signal Corps; Commander Reed M. Fawell and other officers of the Navy. Immediate steps were taken to put into effect as rapidly as possible all of the measures which had already been agreed upon. Captain Todd reported that the United States naval authorities had adopted adequate measures to protect the naval wireless stations from attack.

Information furnished by the Navy concerning the enemy's intentions seemed to be well founded, for while the German submarine vessels were operating on the Atlantic coast of the United States, two submarine cables were cut about 100 miles from New York, one a cable from New York to Canso, which stopped working at 12:35 p. m. on May 28th; the other a cable from New York to Colon, which began to fail at 3:30 p. m. on May 28th, and went out of service entirely at 9:30 p. m. on the same date.

These two cables were promptly repaired, but had this not been done, their cutting could not have substantially affected transatlantic communications, because only one of them was used for that traffic, and that only as far as Newfoundland. For this section, land lines were also available.

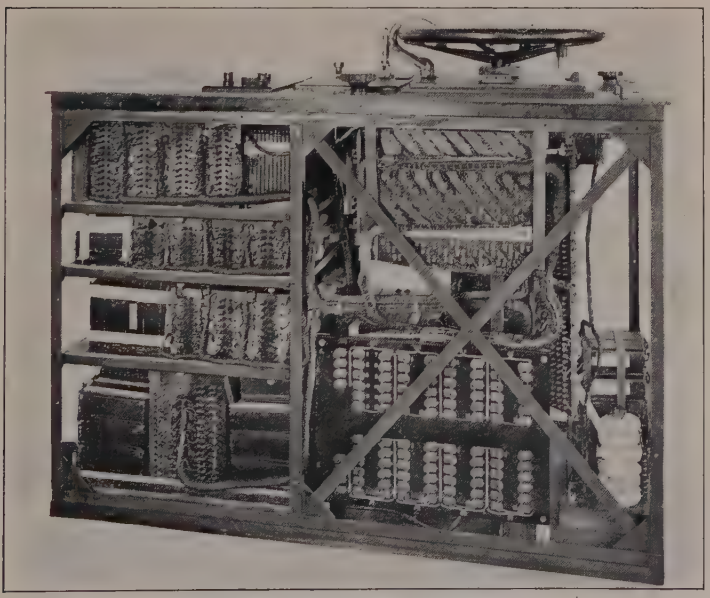
The severed section of each cable was carefully studied by Colonel Carty and other cable experts. The conclusion was unanimous that the cables were cut, and not merely worn out or damaged by ordinary causes. The points at which the armoured wires were severed in both cables showed clearly the evidence of a sharp-cutting tool, and the absence of rust on the ends of the armor showed that the cut was of recent origin. The nature of the cut, and the fact that the enemy's submarines were operat-



U. S. Official

THE DEPTH BOMB

In "tagging the tin fish" by means of the various electrical devices produced by the Western Electric Company in coöperation with the General Electric Company and the Submarine Signalling Company, the depth bomb was the final "you're it."



ELECTRICAL COMPENSATOR

Used on chasers and destroyers for locating submarines by sound ranging at sea.



PERSHING WIRED FOR THESE

Note lance pole telephone construction in background showing wires hastily built on veritable reeds.



"IT LOOKED LIKE A BREWERY"

was the report, and that is why they executed this laugh as a unit. Note balloon telephone for direct report on observation from the air to the ground station.

ing on our coast at the time, taken in connection with the other circumstances of the case, pointed strongly to the conclusion that the interruption was produced deliberately by the enemy for the purpose of destroying telegraphic communication.

While indefinite reports were received concerning the cutting of cable elsewhere, no further damage was done to cables on the coast of the United States, and telegraphic communication, by cable and by radio, between the War Department and the American Expeditionary Forces in Europe was at all times maintained.

In its co-operation with the United States Army and with the Allies in this project, the work performed by the United States Navy was indispensable. It was executed with vigour and with skill, and was successful.

A second phase of the transatlantic communications' problem consisted, not in preventing the enemy from interrupting our communications, but in determining in what manner and to what extent the enemy countries themselves were utilising transatlantic electrical communications.

Accordingly the Chief Signal Officer, on July 12, 1917, issued office memorandum No. 51, of which paragraph 1 follows:

> "A board of officers, consisting of Major J. J. Carty, Major George M. Yorke and Major Charles P. Bruch, Signal Officers' Reserve Corps, is hereby appointed to meet in New York City at such times as may be designated by the President thereof for the purpose of carrying out special instructions which will be communicated to the board by the Chief Signal Officer of the Army."

The Chief Signal Officer on the same day issued special instructions to this board as follows:

> "Grave concern is felt by the War Department due to the fact that there is existing, without doubt, some means by which communication is being maintained between agents of the German Government in the United States and Germany. The determination of these means is a matter of utmost importance to the Government. The Chief Signal Officer of the Army, realizing the vast experience of the three members of the board appointed by office memorandum No. 51 in matters pertaining to the transmission of information, desires that

they give consideration to the matter of determining by what means German agents are maintaining communication between this country and Germany, and that the board submit recommendations to this office as to the best means of preventing the same. It is of the utmost importance that all the deliberations of the board be carried out in the most confidential manner."

Immediately upon receipt of the above instructions Colonel Carty, who had been appointed President, held a meeting of the board at which various extraordinary precautions were determined upon and taken up with the cable and the telephone and telegraph companies. As all of the members of the board had been, in their civilian capacity, officials of telephone and telegraph companies, they were better able, because of their intimate knowledge of the working of these companies, to secure their intelligent co-operation. It became evident, as the work of the board progressed, that one of the measures which might be employed by the enemy was the sending of military information under the guise of apparently harmless messages to neutral countries, which then would find their way to the Central Powers. As this was a matter which involved the censorship of cables, the President of the board worked in close co-operation with Captain D. W. Todd, U. S. N., the Director of Naval Communications, who had charge of the naval censorship. It was found that a thorough investigation of the handling of cable traffic and of all the personnel concerned therewith had been conducted by the censorship officials and that rigorous methods were adopted in the handling of cable traffic. As a result of most stringent regulations of the Naval Censor, it was made certain that the sending of clandestine messages was minimised if not prevented.

It was impossible, however, to prevent the enemy from sending from its high-power radio stations messages which could be received in the United States and in the countries to the south. The Radio Section of the Signal Corps, therefore, systematically intercepted enemy radio cipher messages from these stations, all of which were duly reported to the Military Intelligence Division.

Confidential information, very circumstantial in character, was received from official sources by the President of the board to the effect that a cable had secretly been laid across the Atlantic by the enemy and that the American end of the cable terminated on the New England coast; that the European end of the cable terminated in a submerged buoy off the coast of a neutral country;

that at frequent intervals connection was made at the buoy with a German submarine vessel equipped with cable sending and receiving apparatus; and that in this manner prompt and reliable communication was maintained between the United States and Germany. It was stated further that the deep-sea portion of the cable had been laid by a neutral vessel and that the shore end on the New England coast was of short length and of very light construction and was laid by a German submarine.

The report, while containing elements of improbability, came from a responsible source and could not be ignored. Arrangements were made, therefore, with Mr. George H. Dresser, General Superintendent of the New England Telephone & Telegraph Co., with Major G. K. Manson,[1] Signal Officer's Reserve Corps, not on active service, Chief Engineer of the New England Telephone & Telegraph Co., and with Mr. James T. Moran, President of the Southern New England Telephone & Telegraph Co., and Mr. H. C. Knight, General Manager of the company, to obtain their confidential co-operation and to provide the services of competent and trustworthy personnel from their respective companies, thoroughly familiar with the coast of New England. This personnel consisted of telephone officials, foremen, and linemen, whose daily work gave to them intimate knowledge of all of the wires on the coast of New England. Through these agencies the entire coast from the Canadian border to New York was thoroughly searched for evidence of an enemy cable connection. No enemy cable was found and the investigation was so thorough that it became certain that it did not exist. While this was the result which might be expected, the question was so important as to demand a positive answer and this was obtained.

A third phase of these transatlantic communications was developed by the Chief Signal Officer, who directed Colonel John J. Carty to study the possibility of sending messages in plain English from the War Department at Washington to the American Expeditionary Forces in France and England in such a manner that they could not be intercepted by the enemy, the object of this being to save valuable time which was being consumed in coding and decoding cablegrams.

Colonel Carty undertook this study as directed, and gave his attention, first, to the remarkable printing telegraph system which had recently been perfected in the United States. By this

[1] It was Major Manson who organised the 401st Telegraph Battalion, from the New England Telephone and Telegraph Company.

system eight messages may be sent simultaneously over one telegraph wire, each message being received in printed form like the page of a letter written upon the typewriter.

To intercept one or more of the eight messages thus being sent would be impossible by any ordinary means, particularly those heretofore found effective in tapping wires employing the Morse code. A thorough study, however, revealed the fact that by using an instrument known as the oscillograph, which records upon photographic paper the most sensitive electrical currents, the message could be intercepted. By a study of the impulses required for the formation of the telegraphic letter and by analysis of the resultant curves of the combined eight messages, the contents could be read, although this would require extreme skill and take a long time. This demonstrated that the printing telegraph system, without further invention, could not be depended upon to safeguard a message sent in plain English against the efforts of an enterprising enemy with proper scientific knowledge and equipment.

Other methods of safeguarding the land lines against wire tapping might be adopted if the security of the message upon the ocean cable could be assured. Up to the time of the making of this study it had been generally assumed that it would be impracticable to tap an ocean cable without producing an electrical disturbance at the ends, which would undoubtedly result in discovery.

After a careful inquiry into this matter, Colonel Carty reached the conclusion that it might be possible to tap successfully, and without discovery, an ocean cable, by employing some recent electrical discoveries. He devised a tentative scheme which was submitted to the engineers of the American Telephone & Telegraph Company, who reported that the scheme was probably workable. Accordingly, experts of that company and the Western Electric Company undertook the development of the necessary apparatus. Radical improvements were made by them upon the first suggested idea; special apparatus was constructed; a ship was equipped and put to sea; connection was made with an Atlantic cable and messages were intercepted, and a clear, legible record of them was obtained. All of this was accomplished without producing any disturbances whatever in the working of the cable or giving the slightest indication upon the most delicate apparatus at the ends of the cable.

It was clearly demonstrated that cable tapping could be ac-

complished in this manner and that cable tapping so accomplished could not be detected by any possible means at the shore ends. This valuable discovery was communicated to the Military Intelligence Division and so to the Navy and to the Allies. It demonstrated that it would be unsafe to attempt to send plain English messages through the ocean cables, and indicated a method which, if known to the enemy, might be employed against us. It was decided that until some new discovery was made, the ultimate protection of the secrecy of messages must be found in the use of the code or cipher.

But the use of code or cipher, as previously remarked, has this vital drawback: it ceases to be code or cipher as soon as the key is discovered, and such discovery has been found by experience to be sooner or later inevitable.

Hence the quest for an absolutely undecipherable code, whose outcome has already been described in the previous chapter.

CHAPTER XXXVII

OVER AND UNDER THE SEAS

When, on the night of January 31, 1917, William II gave Ambassador Gerard six hours' notice that submarine frightfulness was to be resumed, he was acting on information of the most convincing character that England would be starved into submission long before America, even if she declared war, could possibly affect the situation.

The very first month of unrestricted submarine warfare seemed to confirm this position: 540,000 tons of Allied shipping were sent to the bottom during the month of February, 1917. The next month saw this harvest of sub-sea *schrecklichkeit* approach close to 600,000, or at the rate of 7,000,000 tons a year.

Things began to look black indeed. When Vice Admiral Sims reached London in April, 1917, he was frankly told that Great Britain would have to give up the war by November unless the submarine campaign were checked in the very near future. "Briefly stated," Sims reported back to Washington, "I consider that at the present moment we are losing the war."

What to do? How fight an enemy you couldn't see? Unless an answer were found very soon, England must give up. That very month saw the situation grow 50 per cent worse; 874,576 additional tons of Allied shipping were no more.

England was put on the strictest rationing: the pinch of starvation had begun to be felt.

What was the answer? There were several, but none of these was final.

First, the destroyer. If the destroyer could get near enough, she could sink the submarine. But so far, it was for the submarine to say whether the destroyer should get near enough. Invisibility controlled.

Then there were the convoy, the mine fields, mystery ships, airplanes, other methods. Still, with all these, invisibility controlled.

Finally, there was the depth charge. The submarine feared the depth charge as she feared nothing else. It was, in fact, probably the most effective single weapon against the submarine. Drop your pattern of depth charges in the neighbourhood of the submarine, and that was an end to the submarine. But—you had to be in the neighbourhood of the submarine, or the depth charge did no good; and early in 1917, it was still largely the submarine's prerogative to say if she would be in that neighbourhood. Invisibility still controlled.

The problem, then, was to overcome the submarine's advantage of invisibility; to devise ways and means of hunting the submarine down, rather than to leave it to the submarine to determine the point of attack. Until that was done, the submarine problem remained.

It was the case of a blind man fighting for his life. It did not take long to see that the blind man's one hope lay, not in trying to find eyes, but in sharpening his ears.

In May, 1917, there was organised a Special Board of the Navy Department to Consider and Experiment with Anti-Submarine Devices. The regular members of the Com-

mittee were officers of the Navy. As advisory members, the Secretary of the Navy named Dr. F. B. Jewett, Chief Engineer of the Western Electric Company, Dr. W. R. Whitney, Research Engineer of the General Electric Company, Mr. H. J. W. Fay, Vice President of the Submarine Signal Company, and Professor R. A. Millikan of the University of Chicago, whose work as Executive Secretary of the National Research Council has already been referred to.

The engineering resources of these three companies represented on the Board, were from that time on at the disposal of the Navy Department in this matter, and a considerable body of their personnel were assigned to study the technical methods of detecting and locating submarines or other vessels. A field station for work was needed at once. It was supplied jointly by the Western Electric Company, the General Electric Company, and the Submarine Signal Company. These organisations set up a co-operative group for field work at Nahant, Massachusetts, with a splendidly equipped laboratory, including two converted yachts supplied by the Navy; and there work which was to affect the trend of the war in a very real way, was begun.

It was a splendid example of the patriotic team work which the war called forth from the industry of the country. The pick of the experts from these three commercial companies were brought together, and their combined endeavours welded to a common purpose. Day and night these men of the Western Electric Company, the General Electric Company and the Submarine Signal Company worked as a single unit, carrying out, as part of a single, central goal, the related branches of the same programme.

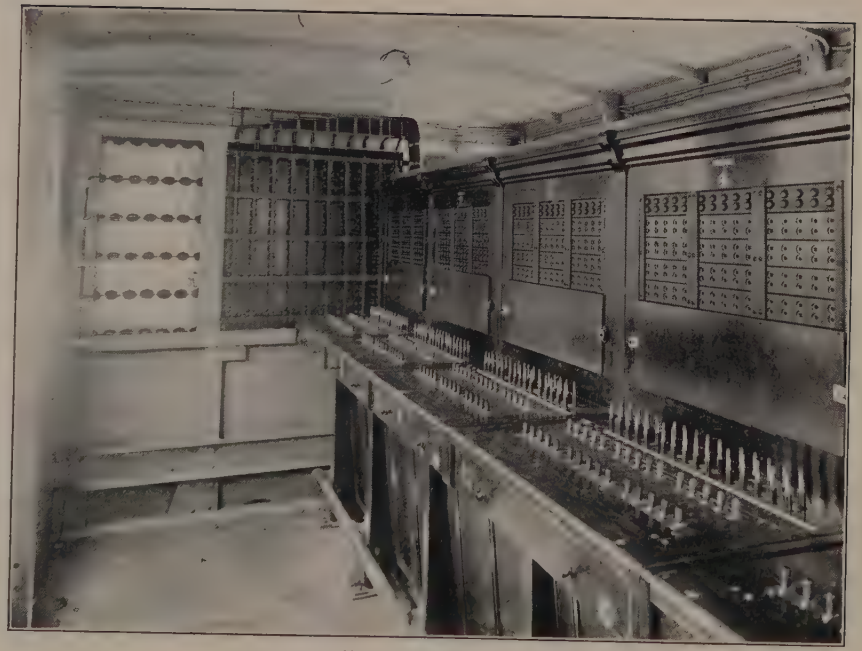
In addition to the Nahant field station and laboratory, the main development headquarters of this Special Board



U. S. Official

"ON WHEELS"

Left: Exterior view of one of the mobile telegraph offices used in France. Right: Interior view of mobile telegraph office. This "telegraph office on wheels" was used in Coblenz, Germany, and for a time was the only American telegraph office in Germany.



"ON WHEELS"

Interior view of mobile telephone office.

was established at New London, Connecticut, as the Naval Experimental Station. Here the Board brought together some of the most distinguished scientists and research workers of the country. Among others there were Professor G. W. Pierce and Professor P. W. Bridgeman of Harvard University, Professor Max Maxon and Professor J. R. Roebuck of the University of Wisconsin, Professor H. B. Smith of Worcester Polytechnic Institute, Professor Ernest Merritt of Cornell University and Professor H. A. Wilson of Yale University.

It was another illustration of the extent to which the great inventions of to-day are co-operative, rather than individual. Indeed, you can scarcely talk about the invention of a single submarine device, because it was really not a matter of invention, but rather of evolution, of co-operative contribution by a wide range of personnel from different commercial organisations.

For example, there was Professor Pierce's "trailing wire," which would ring a bell automatically in a submarine patrol or any other ship that happened to pass immediately over a submarine, by virtue of the magnetic field set up by the submarine, and the induction set up in the wire as a result. The initial impetus for this invention, its original conception, belongs to Professor Pierce. But its development and practical adaptation to the problem in hand, belong unquestionably to the large body of laboratory workers and factory experts of the organisations mentioned.

As previously stated, the problem presented by the submarine was akin to that of a blind man fighting for his life, who must seek salvation not in trying to find eyes, but in sharpening his ears.

Submarines manifest their presence by sending out pro-

peller and other machinery noises, by their magnetic effects, and in other ways.

The sound effects were the most readily used. They constituted the most important class of manifestations that led the submarine to its destruction. The water of the ocean constitutes a large sound-conducting sheet, in which sound waves are confined and propagated with great efficiency. Water is an excellent conductor of sound, transmitting it with a velocity about five times as great as does the air.

When America went into the war, the British and French had been working hard on the submarine problem for many months. They had several purely acoustical devices, and some electrical ones which used under-water microphones.

The leading point of attack developed by the American engineers from the Western Electric, General Electric and Submarine Signal Companies, lay in the application of the "binaural" principle of listening, followed by simple "triangulation."

The "binaural" (two-ear) principle is simply this: Say you are in a room filled with a dozen voices or other sounds simultaneously jarring the air. If you had but one ear, the result would be a jumble of noise, and you could not tell the direction from which any one of the sounds came. Ordinarily, however, you can concentrate on a single conversation out of a dozen going on at the same time. This is because you can tell instinctively the direction from which each voice comes. And you can do this because you have two ears; because one set of sound waves hits the ear nearest the sound before it hits the other ear.

"This principle seems simple enough," said one of the Western Electric Company engineers engaged in this work, "but we had some job trying to convince the others that it

was our one best bet. It furnished the basis for practically all the important work, not only on submarine listening devices, but also on anti-aircraft listening devices, sound-ranging devices in detecting hidden gun emplacements, and the like.

"Given this principle, and all you had to do was to perfect the mechanical means for ideal listening conditions, amplify the range of your hearing by electrical means, establish two or three listening positions, and triangulation enabled you, with fair accuracy, to locate the source of the sound in question."

The application of "triangulation" under actual combat conditions, as described by Vice Admiral Sims, will presently appear.

Given the "binaural" principle, the next problem was to apply it to existing anti-submarine devices, and either to improve those devices or work out new ones adapted to the "binaural" principle.

One of the most promising and widely used devices of the British was the "Nash fish," developed for the British Admiralty by G. H. Nash, Chief Engineer of the British branch of the Western Electric Company. This was a hollow stream line body about 15 feet long, containing microphone detectors. Towed behind the submarine-hunting vessel, it had certain directional properties. The Nahant group immediately got to work on this lead, and before long a host of new "fishes," or submersible containers of microphonic devices for submarine listening, were being tested out. All kinds of "freak properties" were resorted to. At one stage of this work, in an effort to make the "fish" follow the ship at a certain distance below the water and glide along as smoothly as possible, a seal skin was obtained in which to

enclose the wooden "fish," only to be discarded the very next day for the less prodigal and more practicable device of a smooth rubber coating which yielded exactly the same result. Gradually, the "fish" shrank off in size from its Nash ancestor, and before very long, also, its improvement in efficiency became so pronounced as to be unquestionable.

A second device early used abroad, and adapted in this country to the "binaural" principle, consisted of listening tubes. The original British device consisted of pipes lowered in the water, and covered at the bottom by a rubber diaphragm. But the design was very inefficient, inasmuch as the compression of the diaphragm absorbed altogether too much noise, and, consequently, the distances at which submarines could be located were relatively limited. The Western Electric Company designed a microphone to be inserted into the rubber diaphragm, which increased the efficiency of this device tremendously, both as to range over which sound could be heard, and accuracy in locating the direction of sound. If you lowered a couple of these pipes into the water, then noted the results by means of plugs inserted into both ears, you got a difference, infinitesimal though it was, in the time of the arrival of the sound, which afforded a most uncanny sensation, but at the same time instantly gave you the direction from which the sound proceeded.

To this device were added others along the same line by the General Electric and Submarine Signal Companies. The final combined result took the shape of what became known as the "K" and "C" tubes.

Concerning the application of these devices to actual submarine warfare, Vice Admiral Sims has this to say: [1]

[1] In a series of articles published in *The World's Work*, entitled "The Victory at Sea," February, 1920, p. 361. Now published in book form, under the same title.

British inventors had developed several promising hydrophones, but these instruments had not proved efficient in locating a submarine with sufficient accuracy to enable us to destroy it with depth charges. These disappointments quite naturally created an atmosphere of skepticism which, however, did not diminish the energy which was devoted to the solution of this important problem. Accordingly, three trawlers and a "P" boat were assigned to Captain Leigh and with these vessels he spent ten days in the Channel, testing impartially both the British and American devices. No detailed tactics for groups of vessels had yet been elaborated for hunting by sound, and though the ships used were not particularly suitable for the work in hand, these few days at sea demonstrated that the American contrivances were superior to anything in the possession of the Allies. They were by no means perfect; but the ease with which they picked up all kinds of noises, particularly those made by the submarines, astonished everybody who was let into the secret; the conviction that such a method of tracking the hidden enemy might ultimately be used with the desired success now became more or less general. In particular the American "K" tubes and the "C" tubes proved superior to the "Nash-fish" and the "Shark-fin," the two devices which up to that time had been the favourites in the British Navy. The "K" tubes easily detected the sound of large vessels at a distance of twenty miles, while the "C" tubes were more useful at a shorter distance. But the greatest advantage which these new devices had over those of other navies, was that they could more efficiently determine not only the sound, but also the direction from which it came. Captain Leigh, after this demonstration, visited several British naval stations, consulting with the British officers, explaining our sound detection devices and testing the new appliances in all kinds of conditions. The net result of his trip was a general reversal of opinion on the value of this method of hunting submarines. The British Admiralty ordered from the United States large quantities of the American mechanisms, and also began manufacturing them in England.

The incessant and almost feverish grind of the Nahant and New England groups to produce the results thus described by Sims, was not without its amusing episodes. One branch of this study concerned itself with the detection of aircraft from our own submarines, and a device for this

purpose was being tested on board one of the submarines of the U. S. Navy, by several Western Electric engineers.

"Damn nuisances," was the way a number of naval officers on board characterised them.

On one particular morning, these "nuisances" were testing a device attached to the periscope, the object of which was to prove that the location of invisible airplanes could be detected by sound at a range of four to five miles. The objecting naval officers were on deck, the "nuisances" below.

"There go those damn nuisances monkeying with the periscope again," commented one of the naval officers in an ordinary tone of voice to his companion.

Later, at mess, he was approached by one of the engineers who, with a twinkle in his eye, observed,

"Well, I've got good news for you."

"Is that so? What is it?"

"We damn nuisances are going to quit monkeying with the periscope to-morrow. We've finished. And by the way, if you don't want to be overheard while we're 'monkeying with the periscope,' use the deaf and dumb language."

The naval officer jumped. "How in thunder——"

He simply had no idea of the remarkable amplifying qualities of the devices these Western Electric engineers had developed. By the use of what is known as the "six-stage amplifier," through successive stages of amplification, a resultant energy was obtained that literally staggers the imagination. To put it mathematically, these devices, in amplifying sound, produced 10,000,000,000,000 times the original energy.

Some faint conception of what this means can be obtained if we apply it to telephone transmission. The peculiar electric current used in telephone transmission has been

characterised to be "as gentle as the touch of a baby sunbeam, and as swift as the lightning flash . . . so small that the electric current of a single incandescent lamp is greater 500,000,000 times. Cool a spoonful of hot water just one degree, and the energy set free by the cooling will operate a telephone for ten thousand years. Catch the falling teardrop of a child, and there will be sufficient water-power to carry a spoken message from one city to another." [1] And yet the "six-stage amplifier" so multiplies this feeble energy derived from a telephone receiver that, when employed as a transmitter, it will light an ordinary tungsten lamp, or produce a sparking potential of several thousand volts.

In addition to detecting devices used on or from vessels, a different line of development led to a fixed station system adapted for use in the protection of harbours and waterways. The British had attempted a few installations of tripods planted on the sea-bottom supporting microphone detectors connected to shore by submarine cable. The American system, as finally developed, possessed two outstanding improvements. First, a multiplicity of tripods could be placed at intervals along a single submarine cable, the connection of the various detectors to the cable being controlled at a Shore Observing Station by means of selective switching devices. Second, the system was a "binaural" one, and therefore permitted the observers to determine exactly the bearing of a sound heard from any tripod. The actual location of the source of the sound could thus be determined by means of cross-bearings obtained from two or more tripods,—by means of "triangulation."

Still another form of harbour defence against submarines by means of listening devices was developed by these in-

[1] "The History of the Telephone," by Herbert N. Casson, 1913, p. 114.

genious engineers. It has already been noted that submarines produce certain magnetic effects. A magnetic loop system for harbour defence was developed, which consisted of large loops of submarine cable laid on the bottom, led into shore and connected to galvanometers. A photographic recording device showed almost instantaneously when a steel vessel of any sort passed over any one of the loops.

One day the U. S. Navy decided to test both the efficacy of these devices and the wide-awakeness of those in charge of the Shore Observing Station at Boston Harbour. Unbeknown to the observers, one of the U. S. submarines was dispatched to the harbour. Fifteen minutes before the submarine was in range of the guns, the operators had spotted the submarine, and reported its presence to the Charlestown Navy Yard. At the time, of course, those on watch did not know whether it was a German submarine or not; and they experienced "a thrill of anticipation disappointedly dispelled,"—as one of the engineers later put it.

While these developments were under way mainly at Nahant, the group at New London was applying itself with excellent results to the development of other detecting systems, notably those particularly adapted for installations on boats themselves; and chief among these was the wireless telephone, or radiophone, as it has been called.

On November 20th, 1917, Rear Admiral Hugh Rodman, selected to command the representative battleship squadron of the American Navy in its career with the Grand Fleet at war, departed on his flagship, *New York,* with the balance of his squadron of four battleships.

On board the *Delaware,* one of the units of the squadron, was a modest, unobtrusive young man, named E. L. Nelson, one of the Western Electric engineers who had been experi-

menting with wireless telephone sets for submarine chasers.

Only the commander of the battleship knew what he was there for. The "gobs," for the most part, took him for "one of them Navy clerks." They would have looked at you incredulously had you told them that the young man represented, for the time, the United States Government, in the matter of introducing to the British Navy one of the most astonishing developments in the history of American inventiveness.

Nelson relates the following:

On December 7, 1917, we got to Scapa Flow, the Grand Fleet's northern base in the Orkney Islands. And there, lined up to greet us, was such a gala array of war craft as I never expect to see again. The reception was one of those things you tell your grandchildren about.

I was first assigned to the work of equipping three trawlers, experimentally, with the radiotelephone. The installation of the radiophone on these three trawlers was its first use in the war zone.

The fact that the British began on trawlers, shows what little confidence they had in the wireless 'phone. To the British engineers, stroking their chins as they skeptically examined the radiophone apparatus, it was just so much gear.

Now trawlers make, on an average, six knots an hour. If pushed, they may reach eight knots—possibly. This, compared with the speed some of the German submarines were making—16 knots—made the idea of our locating and getting a submarine seem a bit ridiculous.

None of us were too keen about it. I had it on the rest of them, though, because I knew that the radiophone would enable the three trawlers to act as one. Soon my conviction was shared by the rest, for there was perfect correlation at all times between the trawlers.

After eight days with the trawlers, I proceeded with the installation of the radiophone on the other craft, and before long, everyone connected with the radiophone realised that it was "the real thing."

No code was used at first. It was a bit reckless, but it seemed certain that the Germans could not possibly pick anything up in

this way. Later, when we thought the Germans might have picked the thing up, we used code. Ships were designed variously as Wine - Gin - Beer, Red - White - Blue, Cow - Bull - Calf, and by other simple terminology that could not be forgotten or confused. If the Germans ever listened in on those conversations through the air, and caught the expression, "Bring the bacon home," I am sure it meant nothing to them, although it was mighty definite to us.

By and by, though, we learned to exercise caution.

During one of the radiophone demonstrations, one Admiral, through his wireless set, kept on asking all kinds of risky questions, which I did my best to evade. Finally he asked, "What is the range of this thing?"

"Normally," I answered him, "the range is not so far, but sometimes it is likely to reach unbelievable distances, so that we must be careful what we say."

The Admiral asked no more questions.

Later, the following year, Craft, of the Western Electric Company, arrived for more extensive demonstration of the wireless telephone. Many of our own naval officers were in the dark about it. During a review of the Grand Fleet in the Firth of Forth, Craft was on board the *New York,* Admiral Rodman's flagship. He was looking for a chance to see the Admiral. The Admiral, on the other hand, was looking for a chance to get at Craft.

It came.

"Are you that wireless telephone fellow?" the Admiral asked somewhat brusquely. He has been described as a blunt, matter-of-fact sailor, with a very-much-to-the-point manner.

"Yup," replied Craft, with a smile. Craft had resigned his commission in the Army, according to common gossip, because he found it embarrassed him in his free use of "Yup."

"Well, where are those things? Show me one of them.

Have you got one around with you? For God's sake, I'm tired of *hearing* about them. I want to *see* one!"

The Admiral saw one. He was openly enthusiastic. Results followed. Results always followed Rodman's enthusiasm.

In all, besides the hundreds of subchasers, 11 cruisers, 28 converted yachts, two destroyers and four land stations were equipped with radio-telephones.

It was the subchasers on which the bulk of installations were made. Experiments had begun, as a matter of fact, with the "mosquito fleet," early in November, 1917. The first installation was made on November 13, 1917, on subchaser No. 325, at Christopher Dock, in New York, by R. A. Heising, A. Haddock and others of the Western Electric Company.

The first group of 12 boats was completely equipped, tested and turned over to the Navy on February 1, 1918. From that time until the Armistice, 344 boats were completely equipped and turned over to the Navy.

Hunting submarines in packs these chasers, by means of the radio-telephone, were kept in constant touch with one another, thereby greatly increasing the effectiveness of their operations.

The Navy also made use of these sets in their hydroplanes. Here the range was somewhat greater than that required on airplanes, reaching to 20 miles in some cases.

CHAPTER XXXVIII

TAGGING THE TIN FISH

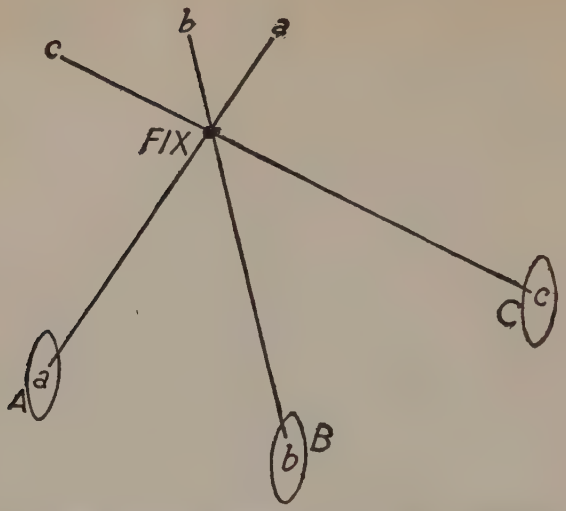
Having followed the progress of the submarine devices in their laboratory and preliminary testing stage, let us follow them still further as they were finally employed against the foe. No description is more faithful, nor more vivid, than that given by Vice Admiral Sims himself:[1]

By the time that Captain Cotten's squadron began work, the hunting tactics that had been developed during their training at New London, had been considerably improved. Their procedure represented something entirely new in naval warfare. Since the chasers had to depend for the detection of the foe upon an agency so uncertain as the human ear, it was thought to be necessary, as a safeguard against error, and also to increase the chances of successful attack, that they should hunt in groups of at least three. The fight against the submarine, under this new system, was divided into three parts—the search, the pursuit, and the attack. The first chapter included those weary hours which the little group spent drifting on the ocean, the lookout in the crow's nest scanning the surface for the possible glimpse of a periscope, while the trained listeners on deck, with strange little instruments, which somewhat resembled telephone receivers, glued to their ears, kept constantly at tension for any noise which might manifest itself under water. It was impossible to use these listening devices while the boats were under way, for the sounds of their own propellers and machinery would drown out any other disturbances. The three little vessels therefore drifted abreast—at a distance of a mile or two apart—their propellers hardly moving, and the decks as silent as the grave; they formed a new

[1] "The Victory at Sea." *The World's Work*, March, 1920, pp. 457 ff. Reprinted by permission of Doubleday, Page & Company.

kind of fishing expedition, the officers and crews constantly held taut by the expectation of a "bite." And frequently their experience was that of the proverbial "fisherman's luck." Hours passed sometimes without even the encouragement of a "nibble"; then suddenly one of the listeners would hear something which his experienced ear had learned to identify as the propellers and motors of a submarine. The great advantage possessed by the American tubes, as already said, was that they gave not only the sound, but its direction. The listener would inform his commanding officer that he had picked up a submarine. "Very faint," he would perhaps report, "direction 97"—the latter being the angle which it made with the north and south line. Another appliance which now rendered great service was the wireless telephone. The commanding officer at once began talking with the other two boats, asking if they had picked up the noise. Unless all three vessels had heard the disturbance, nothing was done; but if all identified it nearly simultaneously, this unanimity was taken as evidence that something was really moving in the water. When all three vessels obtained the direction as well as the sound it was a comparatively simple matter to define pretty accurately its location. The middle chaser of the three was the flagship and her most interesting feature was the so-called plotting room. Here one officer received constant telephone reports from all three vessels, giving the nature of the sounds, and, more important still, their directions. He transferred these records to a chart, as soon as they came in, rapidly made calculations, and, in a few seconds, he was able to give the location of the submarine. This process was known as obtaining a "fix." The reports of our chaser commanders are filled constantly with reference to these "fixes"—the "fix" being that point on the surface of the ocean where three lines, each giving the direction of the detected sound, cross one another. The method can be most satisfactorily illustrated by the diagram shown on the next page:

In this demonstration the letters A, B, and C, each represent a subchaser, the central one, B, being the flagship of the division. The listener on A has picked up a noise, the direction of which is indicated by the line a a. He telephones by wireless this information to the plotting room aboard the flagship B. The listeners on this vessel have picked up the same sound, which comes from the direction indicated by the line b b. The point at which these two lines cross is the "fix"; it shows the spot on the ocean where the submarine was stationed when the sound was first detected.



HOW THE LISTENING DEVICES LOCATED A SUBMARINE

The reason for having a report from the third subchaser C, is merely for the purpose of corroborating the work of the other two; if three observations, made independently, agree in locating the enemy at this point, the commanding officer may safely assume that he is not chasing a will-o'-the-wisp.

But this "fix" is clearly the location of the submarine at the time when it was first heard. In the great majority of cases, however, the submerged vessel is moving; so, rapidly as the men in the plotting room may work, the German has advanced beyond this point by the time they have finished their calculations. The subchasers, which have been drifting while these observations were being made, now start their engines at full speed, and rush up to the neighbourhood of their first "fix." Arrived there, they stop again, put over their tubes, and begin listening once more. The chances are now that the noise of the submarine is louder; the chasers are getting "warmer." It is not unlikely, however, that the direction has changed, for the submarine, which has listening devices of its own—though the German hydrophones were ludicrously inferior to the American—may have heard the subchasers and may be making frantic efforts to elude them. But changing course will help it little, for the listeners easily get the

new direction and send the details to the plotting room, where the new "fix" is obtained in a few moments. Thus the subchasers keep inching up to their prey; at each new "fix" the noise becomes louder, until the hunters are so near that they feel justified in attacking. Putting on full speed, all three rush up to the latest "fix," drop depth charges with a lavish hand, fire the "Y" howitzers, each one of which carries two depth charges, meanwhile manning their guns on the chance that the submarine may decide to rise to the surface and give battle. In many of these hunts a destroyer accompanies the subchasers, always keeping at a considerable distance, so that the noise of its propellers will not interfere with the game; once the chasers determine the accurate "fix," they wire the position to this larger ship, which puts on full steam and dashes with the speed of an express train to the indicated spot, and adds ten or a dozen of its twenty to thirty depth charges to those deposited by the chasers, the latter carrying twelve.

Another account of anti-submarine activities, from the standpoint of one of the experts who was not only engaged in the development of the special listening devices, but also in their final test under combat conditions, will be of special interest. Within a remarkably short time after the Nahant and New London engineers had got to work, the Navy Department organised a special service party under the command of Captain R. H. Leigh, U. S. N., and dispatched ten tons of the listening apparatus to be tried out in European waters. Reference to this expedition has already been made in the extract from Vice Admiral Sims' narrative, and in the story told by E. L. Nelson, of the Western Electric Company. The story as told by C. F. Scott, of the General Electric Company, presents a still different angle:

The principal bases from which American destroyers operated were Queenstown, Ireland; Brest, France, and Gibraltar; the first named being the largest base of the three.

The submarine chaser bases were at Queenstown and Plymouth, England; and Corfu, France.

The American submarines were based at Berehaven, Ireland, and the Azores. All the navigation charts of the waters around the British Isles, like the English Channel, North Sea, and Irish Sea, where the submarine warfare was most active, were divided into squares, lettered and numbered for quick reference as to positions of torpedoed ships or enemy submarines sighted by surface craft or airplanes.

The party under Captain Leigh had also worked out the tactics necessary for the detection, pursuit, and destruction of U-boats, and used three fishing trawlers of 9 to 10 knots speed. On December 30, 1917, we steamed out of the harbour for our first patrol in English waters. The Channel lived up to its reputation of being the roughest body of water for its size in the world.

A "P" boat, a small type of high speed destroyer developed for the war, accompanied us as an escort.

The day after New Year's we received a wireless from an airship that a submarine had been sighted. We steamed over, got out our devices, but couldn't hear a thing. Another message from the airship changed the sub's position, so that we altered our course and obtained a clear indication, from the listening device. The U-boat was moving slowly up the Channel submerged.

We gave the "P" boat a "fix" on the spot where our indication showed the submarine to be. She ran over the place, dropping a "pattern" of depth charges and soon we began to see tremendous amounts of oil rising to the surface.

A trawling device had been developed which indicated whether contact with a submarine was made. After the oil came up we got out our trawling device and ran over the area for about an hour and finally got an indication. We threw over a buoy to mark the spot and anchored for the night. Next morning we trawled again and got another contact within 100 yards of the buoy. We had destroyed a submarine in our first test.

The British Admiralty thought well of the devices and many were ordered from the United States. We had taken over detailed drawings of all the apparatus and allowed them to build it themselves from our drawings.

About May, 1918, our own ships began to come over with all these devices installed. They were also equipped with radiotelephones, depth charges, and "Y" guns. A "Y" gun is a casting with two arms forming a "Y." Each arm holds a depth bomb, which can be shot out by means of an auxiliary powder charge to a distance of 100 feet.

When the American submarine chasers began to arrive they were assigned to the Channel where the German submarine activities were greatest, and we did a good deal of patrolling in the early Spring with these chasers. The second lot of chasers were ordered to Corfu in the Adriatic in June. We had 36 chasers based in a little bay on the island, and the barrage of boats extended across the Otranto Strait, a distance of about forty miles. The chasers were operated in units of three, which kept about one mile apart on patrol. A distance of five miles was kept between units. The conditions in the Adriatic were ideal for hunting submarines. The water was very deep around Otranto Strait, ranging from 400 to 600 fathoms, which meant that the submarines when hard pressed could not seek shallow water, as was their custom in the English Channel and the North Sea.

The main Austrian submarine base was at Pola, which is at the head of the Adriatic. Cattaro, further down the coast, was also used as a base.

The German submarines leaving Pola were obliged to go through Otranto Straits to get to the Mediterranean, and once through they had things practically their own way, as there were few patrol boats in the Mediterranean. The tonnage sunk during the first three years of the war shows the condition that existed before the Otranto barrage was put into effect.

The submarine chasers while on the barrage were constantly in sound contact with enemy submarines, especially at night, as they usually made the attempt to get through during the dark. They could be heard for an hour or two before they came to the line. The difference in sound between an oil engine and an electric motor is so distinctive that it was comparatively easy to tell when they changed from one to the other, which was necessary as soon as they submerged, as they knew approximately where our line was located and they invariably submerged two or three miles before they reached the line.

When the submarine had approached sufficiently close, the unit manœuvred into position for the attack. The attack was usually made when the submarine was 400 to 500 yards ahead, and all three boats of a unit, steaming full speed ahead, would lay a pattern of depth charges over the area where the plotted position of the submarine showed it to be. Many successful attacks were made, and one in particular was exciting.

One of the boats in a unit reported hearing what sounded like

a submarine. In a few minutes all three listeners had picked him up and the bearing of his course was being plotted. The middle chaser, which was the flagship, was getting readings which showed that the submarine was in a direct line astern and steaming toward her.

Suddenly the water began to slap the bottom of the boat, so that everyone on board felt it and the next minute the observer reported that his bearings on the submarine had changed from dead astern to our bows. The submerged submarine had passed directly under the centre boat. All three boats were immediately got under way, and the attack made. After all the depth charges had been dropped, the boats were stopped and observations were again taken. A propeller was heard to start up and ran for about 30 seconds, and then a crunching noise was heard, and although the boats stood by until dawn no further sound was noted. The unit had been blown out of position by a high wind during the early morning, so that when the boats steamed back at daybreak to where the attack had been made, an oil slick two miles long by 800 yards wide was on the surface of the water. The submarine was doubtless put out of control, and after getting down to 300 or 400 feet in depth, had collapsed, due to the tremendous pressure at these depths.

The addition of listening devices to all American submarines was of tremendous assistance to them when out on patrol. The American submarine base was at Berehaven, Ireland, and submarines operated from there off the west coast of Ireland, on the lookout for U-boats. Up to the time that we entered the war, submarines, once they submerged below periscope depth, were blind and deaf. The development of the listeners for use with submarines gave them an added sense which they used constantly after they got into the war zone and began anti-submarine warfare.

An incident combining the comic with the dramatic is related by Vice Admiral Sims in the account previously cited:[1]

We have evidence—conclusive even though somewhat ludicrous—that the American device on a British destroyer "got" one of these submarines. One dark night this vessel, equipped with the

[1] "The Victory at Sea," *The World's Work*, March, 1920, pp. 472-3. Reprinted by permission of Doubleday, Page & Company.

"C" tube, had pursued a submarine and bombed it with what seemed to have been satisfactory results. However, I have several times called attention to one of the most discouraging aspects of anti-submarine warfare: that only in exceptional circumstances did we know whether the submarine had been destroyed. This destroyer was now diligently searching the area of the battle, the listeners straining every nerve for traces of her foe. For a time everything was utterly silent; then suddenly the listener picked up a disturbance of an unusual kind. The noise rapidly became louder, but it was still something very different from any noise ever heard before. The "C" tube consisted of a lead pipe—practically the same as a water pipe—which was dropped over the side of the ship, fifteen or twenty feet into the sea; this pipe contained the wires which, at one end, were attached to the devices under the water, and, at the other end, reached the listener's ears. In a few seconds this tube showed signs of lively agitation. It trembled violently and made a constantly increasing hullabaloo in the ears of the listener. Finally a huge German, dripping with water like a sea lion, appeared over the side of the destroyer and astounded our British Allies by throwing up his arms with "Kamerad!" This visitant from the depths was the only survivor of the submarine which it now appeared had indubitably been sunk. He had been blown through the conning tower, or had miraculously escaped in some other way—he did not himself know just what had taken place—and, while floundering around in the water in the inky darkness, had, by one of those providences which seemingly happen only in war time, caught hold of this tube, and proceeded to pull himself up hand over hand until he reached the deck. Had it not been for this escape, the British would never have known that they had sunk the submarine!

In writing to our officers about this episode, the British commander said:

"We have found a new use for your listening device—salvaging drowning Huns."

Finally, there is the stirring account given by Sims of the action at Durazzo, an Austrian port on the Adriatic, whence Germany and Austria were sending supplies to their Bulgarian allies. The destruction of Durazzo as a base was the

object of this action, and twelve American subchasers assisted in the operation:[1]

At 2:30 Wednesday morning the chasers left Brindisi, steering a straight course to Durazzo. The night was very dark; the harbour was black also with the smoke from the cruisers and other crafts, which were making preparations to get away. After steaming a few hours, the officers with their glasses obtained their first glimpse of Durazzo; at this time there was nothing in sight except the chasers, as the larger ships had not yet arrived. Captain Nelson knew that there were two or three Austrian destroyers at Durazzo, and his first efforts were devoted to attempts to persuade them to come out and give battle. With this idea in mind, the chasers engaged in what they called a "war dance" before the port; they began turning rapidly in a great circle, but all to no purpose, for the Austrian ships declined to accept the challenge. After a time the smoke of the Italian cruisers appeared above the horizon; this was the signal for the chasers to take their stations. Durazzo is located in an indentation of the coast; at the southern extremity of the little gulf the land juts out to a point, known as Cape Laghi; at the northern extremity the corresponding point is Cape Pali; the distance between these two points is about fifteen miles. Two subchaser units, six boats, were assigned as a screen to the Italian cruisers while the bombardment was under way. One unit, three boats, was stationed at Cape Pali, to the north, to prevent any submarines leaving Durazzo from attacking the British cruisers, which were to approach the scene of activities from that quarter, and another unit, three boats, was stationed off Cape Laghi. Thus the two critical capes were covered against submarine surprises, and the attacking vessels themselves were effectively screened.

The Italian cruisers sailed back and forth for about an hour, blazing away at Durazzo, destroying shipping in the harbour, knocking down military buildings, and devastating the place on a liberal scale, all the time screened in this operation by our chasers. Meantime unit B, commanded by Lieutenant-Commander Bastedo, had started for its station at Cape Pali. The Austrian shore batteries at once opened upon the tiny craft, the water in their neighbourhood being generously churned up by the falling shells. Meanwhile the British cruisers, after steaming for a while east, turned south in order to take up the bombarding

[1] "The Victory at Sea," *The World's Work*, March, 1920, pp. 474-476.

station which, according to the arranged programme, the Italian warships were about to abandon. The three screening chasers were steaming in column, No. 129 bringing up the rear. Suddenly this little boat turned to the right and started scampering in the direction of some apparently very definite object. It moved so abruptly and hastily that it did not take the time even to signal to its associates the cause of its unexpected manœuvre.

On board No. 215, there was some question as to what should be done.

"Let's go," said Commander Bastedo. "Perhaps he's after a submarine."

No. 215 was immediately turned in the direction of the busy No. 129, when the interest of its officers was aroused by a little foamy fountain of spray moving in the water slightly forward of its port beam. There was no mystery as to the cause of that feathery disturbance. It was made by a periscope; it was moving with considerable speed also, entirely ignoring the subchasers and shaping its course directly toward the advancing British cruisers. Commander Bastedo forgot all about subchaser No. 129, which apparently was after game of its own, and headed his own boat in the direction of this little column of spray. In a few seconds the periscope itself became visible; Commander Bastedo opened fire at it with his port gun; at the second shot a column of water and air arose about six feet—a splendid geyser which informed the pursuer that the periscope had been shattered. By this time the third chaser, No. 128, was rushing at full speed. The submarine now saw that all chance of attacking the British ships had gone, and turned to the south in an effort to get away with a whole skin. But the two subchasers, 215 and 128, quickly turned again and started for their prey; soon both were dropping depth charges and shooting their "Y" guns; and a huge circle of the sea was a mass of explosions, whirling water, mighty eruptions of foam, mist, and debris—and in the mass, steel plates and other wreckage flew from the depths into the air.

"That got him!" cried the executive officer from the deck of No. 215, while the crew lifted up its voices in a shout that was reminiscent of a college yell.

It was not until this moment that Commander Bastedo and his associates remembered the 129, which, when last observed, was speeding through the water on an independent course of her own. In the midst of the excitement there came a message from this boat:

"Submarine sighted!"

Then a second afterward came another message.

"My engines are disabled."

In a short time Bastedo had reached the boat.

"Where is the submarine?"

"We just sank it," was the answer. No. 129 had dropped eight depth charges, one directly over the Austrian boat; in the water thrown up the officers had counted seven pieces of metal plates, and the masses of oil and bubbles that presently arose completed the story of the destruction. Meanwhile the British cruisers had taken up their station at Durazzo and were finishing the work that made this place useless as a military headquarters.

Not a man in the whole American force was injured; in a brief time the excitement was all over, and the great ships, screened again by the wasps of chasers, started back to Brindisi. The impression made upon our Allies was well expressed in the congratulatory message sent to me in London by Commodore Kelly, who commanded the British cruisers in this action.

"Their conduct," he said, "was beyond praise. They all returned safely without casualties. They thoroughly enjoyed themselves."

It was in this action that Walter P. Groszmann, of the New York Telephone Company, commanding Submarine Chaser 327, distinguished himself for exceptional valour in action. As related by *The Telephone Review:* [1]

Suppose you were the commander of Submarine Chaser 327, and were detailed to assist an attacking squadron of about 35 vessels and 45 airplanes to wipe out a submarine base at Durazzo, an Adriatic port, and were in the midst of a first-class naval battle.

And suppose, while you were guarding the north entrance of the harbour, together with two other chasers, you saw an enemy destroyer carrying at least six four- to six-inch guns (while your chaser had only one three-inch gun), trying to sneak out the south entrance, what would you do?

There was only one thing to do, and that Lieutenant Walter P. Groszmann, then commander of Submarine Chaser 327, and his companions did,—and that was to stop them.

Two of the three chasers made a dash for the destroyer, whereat

[1] February, 1920.

its commander judged discretion the better part of valour, and withdrew; which shows how anxious the enemy was to mix it up with anything that showed the American flag.

For marked valor in action, Lieutenant Groszmann, who is now back in the plant department of the Company, received no less than three decorations,—the Navy Cross (American), the Distinctivo di Guerra, and the La Croce al Merito di Guerra (both Italian).

* * * * * * *

If one glances at the U. S. Government chart of submarine sinkings, he will note a steady decline in the tonnage sunk by German submarines from that top peak of April, 1917, sinkings, down through the succeeding months of the war. By November, 1917, it has dropped to one third the April figure, and by the Summer of 1918, it became evident that the submarine menace had been met and its ominous threat lost in relative impotence.

Hundreds of thousands of American troops were crossing each month, and the German submarine was unable to prevent their crossing.

What Germany had most feared was now taking place.

An American army was arriving in force.

Daily the Eiffel Tower kept sending its bulletins broadcast so that all who read—including the enemy—might understand:

Ten thousand Americans arrived to-day—and more are coming!

The Germans drank this in like so much poison to their morale.

Cantigny had been accomplished, the enemy had been stopped at Chateau-Thierry, the last vicious lunges of Ludendorff on the Noyon-Montdidier and Champagne-Marne sectors had been successfully resisted.

The time had now come for the tide to turn.

CHAPTER XXXIX

THE TIDE TURNS: AISNE-MARNE

As everyone now knows, it was a fundamental part of the plans of the Allied General Staff—plans developed fully a year before the Fall of 1918—that the Great Allied Push was to be staged for the Spring of 1919.

The idea in the interim was merely to hold, hold, hold: to hold off the enemy while the American Army grew to maturity and rounded off its training; while its air, ordnance, chemical warfare and other relatively incomplete branches reached a stage of effectiveness reasonably in line with the other elements in American military strength. Then in the Spring of 1919, with the full American strength ready to be exerted in co-operation with the Allies, was to come that great forward movement which, it was felt, would prove irresistible.

Never throughout 1917, nor during 1918 until well toward the end of the summer, did the Allied plan contemplate such a whirlwind campaign as was actually waged in the Fall of that year.

The reason for this sudden shift with its world-wide, epoch-making consequences, is now known to all.

As we have seen, Ludendorff had pushed himself into a dangerous salient, the tip at Chateau-Thierry, the northwest corner at Soissons, the northeast corner at Rheims. He had

made two desperate attempts to straighten out this salient: first by a westerly offensive between Noyon and Montdidier, then by an easterly offensive along the Champagne-Marne which proved disastrous and marked the last gasp of German offensive morale.

And then came the revelation.

In a flash, the Great Perhaps revealed itself to Foch like an open book. Now was the opportunity to strike; to strike at the base of this salient; perhaps to convert the salient into a pocket from which the enemy could extricate himself only with the greatest difficulty and heaviest losses; perhaps to hasten the end and shorten the slaughter of this four-year-old nightmare by many, many months, terminating—who knows?—in what might prove a dazzling victory.

And hence the Aisne-Marne Allied offensive, which really continued until the eleventh hour of the eleventh day of the eleventh month of the year 1918.

Foch had "sounded forth the trumpet that never called retreat." The Aisne-Marne was, for the Germans, the beginning of the end.

The great battle opened at 4:35 on the morning of July 18th, following a rainy night during which the distant cannonading was intermittently swallowed up by Nature's own thunder.

It was a complete surprise for the enemy. Everything indicates that they never looked for the sudden stroke that fell upon them. One German officer was captured in his pyjamas.

The suddenness with which this stroke was carried out was one of the greatest tests ever imposed upon wire communication units in the field. Indeed, nowhere can we

follow the progress of the offensive better than in the rapid, day-to-day shifts of telephone exchanges that had to be installed at the never-resting, ever-on-the-jump American divisions employed in the offensive.

The 406th (Pennsylvania Bell) Telegraph Battalion, it will be recalled, had been assigned as Corps Telegraph Battalion for the 1st Army Corps, co-operating with the 322nd Field Signal Battalion as Corps Signal Troops. Hubbell, who had been attached to Signal Corps Headquarters, had again resumed control of his old battalion. At 10 o'clock on the night before the grand offensive, he had called an officers' meeting and announced that the 1st Corps was to make an attack at 4:25 the following morning.

Immediately, as if by clockwork, a pre-arranged programme went into effect. You could hear everything click into its proper place. All the special details, construction, maintenance, repair, etc., were "ready and set to go," awaiting but the word.

At four in the morning, the companies were assembled, trucks loaded with wire so arranged that it could be run off from the reels as the trucks advanced, and the sections equipped and held until further orders. Lieutenant Price, on the night of the alert, had been dispatched in a motorcycle with instructions "to locate and stay with" a Major Alfonte, Signal Officer of the 26th (Yankee) Division. Captain Coates with his section had been sent to run a line from the main road forward to an engineers' dump at Saacy, and D Company of the 406th had been ordered to Montreuil, there to await instructions. Donaldson had been detailed to staff duty at Corps Headquarters, and Hasskarl, now with E Company of the 406th, took charge of the telephone exchange at La Ferte. The men in the telephone exchanges

were instructed to refuse all telephone service to those not on a preferred list, and to make an extra effort to keep the lines working.

Keeping the lines working, these men were shortly to learn, particularly from the Montreuil and Champigny exchanges, was to be no mean task, with shells falling thick and fast about them. According to Dickson's report of what took place on the morning of this attack:

> About eleven-thirty all our lines to the 26th Division went out. Two of the men started following the line and about five hundred feet down the hill they tumbled into a shell hole. The shell had fallen right on our line and we were minus about seventy-five feet of twist on each circuit. This was repaired in quick time and the boys just returned to the dugout, when almost all of our circuits to the rear, forming the axis of liaison with the 1st Corps Headquarters, went out. A gang was immediately started and found the line almost completely broken down by shell fire. This gang did not get back till the following night, as they would no sooner get one break patched up than another shell would come and do the same damage as its predecessor. Toward morning, when it became known that it was our own doughboys who had started the fuss, the tension of our nerves relaxed a little, as the confidence of every American in France was supreme when it came to our boys.

From then on, Division and even Corps Headquarters jumped about with a rapidity as gratifying to the commanding general—since the jumping took place on the heels of the enemy—as it was disconcerting to the details that had to cover them up. As the attack progressed, the 1st Corps advanced its headquarters successively to Montreuil, Buire, Chateau-Moucheton and Fère-en-Tardenois, and maintained its communication to the rear entirely over twisted pair wire circuits, large quantities of which had begun to arrive by the time operations actually started. Telegraph communication was at all times maintained from the peripatetic Corps

Headquarters to the still more peripatetic Division Headquarters; and to the rear, by "simplexing" the twist circuits. Anyone who has attempted to "simplex" twisted pair circuits under ordinary conditions will appreciate what it meant to "simplex" these circuits under fire.

These officers and men were now to learn what it was to rise at 3:30 to 4 o'clock in the morning and retire sometimes after midnight. Long before 5 o'clock in the morning the various sections were to be out on the road, weaving their way to the trains of supply and artillery. But no one complained of long hours or scant rations; the push was now headed in the right direction.

"From that time on," relates one of the battalion members, "we lived on a 48-hour-day schedule, chained to a reel truck, with the everlasting nightmare of 'Button, button, find the next division headquarters' constantly upon us."

The 26th (Yankee) Division was relieved by the 42nd (Rainbow), the 42nd by the 4th, and the 4th by the 77th. Throughout, these Corps Signal Troops stuck to their tasks with unflagging energy, and maintained communication between the various Division and Corps Headquarters with a dependability that reflected itself only too clearly in the policy of the latter. For it was the custom of General Liggett and his Chief of Staff, General Craig, to keep Corps Headquarters close to the front so that movements of divisions could be readily directed. As the progress of the war developed, however, and the Chief of Staff grew more and more to depend upon the reliability of telephone service to the divisions, Corps Headquarters continued to drop further backward to a point more favourable to communication with the vital elements in the rear.

Lieutenant Price, who had been dispatched on a motor-

cycle on the night of the alert to locate and stay with the Signal Officer of the 26th Division, was having his troubles.

"You may find the Major," he had been told, "in a little town called Mery, but if he is not there, try Genevrois Farm." Driving Price was a young daredevil named Magill. Two others, Giles and Halgren, also of the 406th, accompanied them on another motor-cycle with bedding and rations for the group. It was essential to the American advance that the Signal Officer of the 26th Division be located, in order that no hitch should occur in maintaining communication with his ever-moving telephone headquarters.

Squirming, turning, twisting and shooting in and out through congested and almost impossible roads—sometimes, indeed, leaving the road to make it—these men finally located Mery and Genevrois, only to find that they were scarcely more than mere names, had been shelled almost out of existence, and were totally uninhabited. There was no sign of a Major Alfonte.

Price moved on, along a road jammed with artillery and infantry units. By accident, the party ran across the Signal Officer of the 26th Division in an old barn near Lucy. Price was immediately ordered ahead to Lucy, to locate a favourable place for the 26th Division telephone exchange. Price got there about 2 A. M.

The town of Lucy-le-Bocage, one of the places which marked the turn in the tide of the Boche advance, had been reduced to a hopeless mass of debris. The Ambulance Corps was collecting wounded Americans. The dead of both armies were everywhere lying along the roads; carnage had easily outdistanced burial. It was not a pretty sight, and yet——

The church in the centre of town had been almost entirely wrecked, save for a crucifix above the altar. That crucifix

alone was untouched. Many are the tales that have been told of religious figures spared in the general ravages of war,—some of them, no doubt, bordering on the fairyland of miracles. But in the general wreckage at Lucy, that crucifix, shining forth serene and undisturbed, seemed to convey a sacred assurance that out of this horrible welter and shambles, the right would inevitably prevail.

Price and his detail had little time to contemplate the scene about them, but got to work at once. By 6 A. M. the switchboard had been installed, and for one whole day—that first day of the attack—it was to serve as the 26th Division telephone exchange. The next day the Division was to move on to Picardie Farm, close on the heels of the retreating Huns.

By noon of the first day of the grand attack, its magnificent success had become clearly established. About the middle of the afternoon Colonel Voris, 1st Army Corps Signal Officer, together with Hubbell—both enthusiastic over the progress being made by the first real American offensive—arrived at Montreuil for personal observation of what was going on. Anticipating an advance of the Corps, they ordered additional circuits run to Lucy; but, since the roads leading into this town were under enemy observation and shell fire, the work was not to be started until dusk.

Miller and Jensen took their sections out about sundown, and by nine o'clock, had the two circuits strung, terminating them in an orchard at the edge of the town for use in case the circuit already run to this place from Montreuil might not be satisfactory when the Corps moved up. The Division circuit had been run on the ground, and shortly afterward wagon trains began to park in the woods near the road, grinding the field circuits into the mud, cutting the insula-

tion, and making conversation over them almost impossible. The new circuits were strung along the road from the back of the trucks and tied to trees wherever it seemed at all likely that there might be any chance of traffic leaving the road.

On the nineteenth, matters being somewhat stationary, work was again taken up on the cable trench leading into the exchange at Montreuil. A committee from D Company went over the circuits to Lucy, making a critical study of this line in anticipation of many such circuits that would have to be built in the near future. As they approached the little town from Montgivrault, they passed two ammunition wagons moving in the same direction. This combined movement was, apparently, too much for the patient Boche. Fortunately, all halted under a shed in the east end of the town. In another minute—about the time the methodical Boche figured the soldiers should have arrived at the centre of the town—the bombardment began. It was a case of adding ashes to ashes; for it resulted in nothing more than additional destruction to the already crumbling walls and roofs in the village. After the little demonstration had subsided, the telephone committee continued to where the circuits had been terminated. Again they must have been discovered. Two shells landed in quick succession, blowing the circuits to pieces a few yards from where they were standing; and again there was a precipitous retreat to the shelter of a cave. Ultimately—Boche attention having been probably diverted in another direction—the telephone inspection was completed.

That evening the men at Montreuil had assembled to listen to the engineers' band. The officers, from the side of the cable trench, were enjoying the beautiful landscape to the west. Suddenly there was a distant boom, and the ever

ascending whistle of a shell came toward the town. The shell landed in the wire trench half way down the hill, cutting seven circuits, which were soon repaired, and this shell with the others that accompanied it, promptly terminated the concert programme, for everyone immediately sought safety in the caves. There were many bombardments that night in an attempt to reach an American artillery position on the top of the hill east of Montreuil, and the signal garrison spent three long uncomfortable periods closely packed in a cave, it being necessary to assign approximately twenty men to each of the available caves. At two in the morning the guns again became active. Enemy airplanes came over, dropping several flares right in the middle of the courtyard and making everything as bright as day. Some of the men objected to being constantly ordered into the dugouts or caves, but as the bombardment progressed, the objections became less strenuous. One of the strongest objectors describes his conversion to "Safety First" as follows:

> I was sleeping in a little room in the second story of a house when my bunkie called, "What's that zit-zut-zit-zut?" The noise seemed to stop, but we didn't wait for any more and started right down into the cable bury back of the house. Boom! and a flare lit up the quadrangle! Boom! another one! Down went my head in the mud. Oh, what a night! When morning came we saw what a poor marksman Fritz had been, but it didn't seem that way the night before.

Throughout that night, Dickson with his gang of subterranean telephone operators worked frantically to get service over the much repaired lines, desperately endeavouring meanwhile to keep track of the changes as new lines were cut through.

Early on the morning of the twentieth, Lieutenant Price set off once more to keep in closer touch with the advancing

26th Division, whose headquarters was now at Picardie Farm. The Division had strung a single wire from Lucy to Picardie for use with a buzzer. To make a talking circuit, an additional single wire had been run by Miller and Jensen's sections, which had been sent forward to work under Hubbell's direction.

No one knew what direction the next phase of the attack might take. Therefore, the thing to do was to provide against all possible contingencies. Two axes of communication were carried forward, one following the advance of the 6th French Division, which was run by the 322nd Battalion, the other following the advance of the 26th or Yankee Division, which was continued by the 406th. To connect these axes, a line was run from Lucy to Bellau, with a test station established at Lucy. The 1st Corps Signal troops were now ready for further developments.

On July 21st, the Allied lines again advanced. Corps Headquarters moved forward to Montreuil, almost swamping the little exchange with the rush of business that quickly flooded the circuits. Hubbell was again up the line with various construction sections, waiting for an opportunity to jump ahead. He had not long to wait, for the advance continued at such a pace that headquarters decided to move to Epaux-Bezu. Immediately, the sections were started north from Picardie Farm by way of Etrepilly. Progress along this road was extremely slow, due to many large shell holes and wrecks caused by the explosions. Gigantic heaps of debris from demolished buildings blocked the way, and rendered certain streets in Etrepilly entirely impassable. From Etrepilly, one detachment with switchboards and other station material for establishing the new office, was sent up the road to wait at Epaux for further orders, Hubbell himself

going ahead to determine the exact location for the central office, and the best road for the circuits from Etrepilly to Epaux.

The most feasible route for the circuits led over a steep hill. Foust immediately started the construction crew over the hill with their wires. The south side of the hill was a comparatively safe place to work. But having reached the crest of the hill, they found the north slope no place to linger; for it lay entirely exposed to the German positions. Telephone construction down this slope is believed to have established a record. Lickety-split, the circuits were carried down this hill, and soon the lines were brought into a chateau previously selected for this purpose. Right at the edge of the woods, within two hundred yards of the entrance to the chateau, there were several batteries of "75's," whose gunners were working them as fast as guns could be worked. Naturally, this activity drew shells from the enemy, and the vicinity of the chateau soon proved to be a most unhealthful place.

The switchboard had been installed in the chateau basement, and the circuits leading from the rear to Epaux completed, when the order came that Corps Headquarters was to be moved to Buire, about two kilometers to the west, and sheltered from the German positions by a high hill.

"There was little time to cuss the army and its quick changes of plans," records Griest, of the 406th Battalion, "but, with the road filled with traffic, the sections dashed along feeding 'twist' from the back of a truck, throwing it across the trucks and troops moving to the east, so that it might be tied safely to trees; and service was connected at Buire half an hour after the Chief of Staff arrived, with

Hannam and Crainmile operating the board they had set up in a cellar."

These were strenuous days for the construction men, but they had the advantage of being out in the open where they could see what was going on; and this, adding to the excitement, helped to speed up the work.

But for the men working by candlelight at the subterranean switchboards, things were different. The men worked under a double strain, trying to build up connections over almost impossible circuits, always at top speed, and often with nervous and irritable officers adding to the troubles of the operators by telling them what would happen if the connection were not established. Hannam describes the operating situation at Buire Headquarters during the height of the Aisne-Marne offensive:

> Those were awful days, for the American Army hadn't exactly found their confidence and everyone was afraid to move before consulting someone else by telephone. There was a perpetual stream of business day and night and oh, those trunk lines of twisted pair lying all over the roads with trucks running over them, believe me, they were certainly musical. At Buire we slept right alongside the switchboards on a couple of feather mattresses left there by the Germans, after carrying out buckets of bullets, helmets, parts of machine guns, etc., etc. At this point the Germans made quite a stand, so we stayed here almost a week, during which time they moved up the six- and then the nine-inch guns into our back yard. These would have shaken us out of bed if there was any place to be shaken to.

All in all, those signal troops attached to the advancing American columns on that memorable offensive, acquitted themselves in a way that earns for them the lasting gratitude of the American people.

Not all the credit, however, belongs to the advance units. While the advance headquarters was at Buire, the forward

movement suddenly became jeopardised by the failure of signal supplies, particularly twisted pair, enormous quantities of which had been used up during the unprecedented advance. One hundred miles of twisted pair were urgently needed at the earliest possible moment. The task of securing these vital supplies fell to Captain (later Major) Gauss, the energetic Pittsburger of whom mention has been made in a pervious chapter. Gauss was at the Montreuil Headquarters when he got the word from the advance P. C. at Buire. He immediately secured authority to draw the supplies from an advance army park located at Lieusant. Captain H. W. Hart was in charge of this particular park. Gauss knew it, and he also knew Hart. He immediately got in touch by telephone with the latter via Paris.

"Harry," he said, "Hell's busting loose out here, and it's busting our way. We've got to have 100 miles of twist, *toute suite.* The dump at Lieusant is our nearest and best bet. What can you do for us?"

"Hold the wire a minute," responded Hart, and then, after a brief interval, "O. K. Bill, the wire is being loaded."

At seven o'clock that night the wire was being unloaded at Montreuil. Gauss had previously telegraphed the advance P. C. that the wire was being sent by truck to Montreuil, and a number of trucks were started back to get it. Fifty miles of the wire were immediately loaded and started on their way to the advance P. C. before dark.

This was followed by an urgent telephone message from Colonel Voris. "That twisted pair wire," he exhorted, "must be sent over first thing in the morning after it reaches Montreuil."

"Colonel, that wire is on its way over now," came back the reply.

"The hell it is!" The Colonel was incredulous. "I don't doubt your word in the least, but I'll have to see that wire first."

He barely had time to hang up the receiver before the intrepid truck drivers arrived with the wire. It was a splendid example of Signal Corps co-operation and achievement.

And these truck drivers, incidentally, come in for their share of credit for work well done. Throughout not only this engagement, but for the balance of the war, and even before, at Chateau Thierry, the truck drivers from the various Bell Telegraph Battalions had been constantly called upon to help out in one emergency after another. On July 19th, for example, fifteen of the 408th (Northwestern Bell) Telegraph Battalion's heavy trucks, and their drivers under the command of Lieutenant Butt, were detailed to haul ammunition during the height of the Aisne-Marne offensive, the truck train being temporarily assigned to the 1st Corps.

It was an opportunity for the drivers, all telephone men, to show their mettle. During that historical offensive, there was no rest for anyone, and the ammunition trains were kept constantly on the move. Often these men would drive continuously from 40 to 50 hours without rest or relief, and anyone who has driven a Nash Quad knows what that means. Back through the congested traffic of the rear areas during the day . . . up again through the shell torn roads at night . . . all the while realising that the least mishap or collision might block the narrow road over which hundreds of trucks and thousands of men and guns had to pass . . . finding their way by strange routes to the always changing ammunition dumps and batteries . . . under cover of the night and over almost impassable roads,—these telephone men, like old

veterans, showed that they could do other things as well as Signal Corps work when the occasion demanded.

One evening Urffer, of the 406th, driving a Nash truck, ran into an air raid. His account of what followed is of interest:

> I was jammed up on a congested road, with a broken steering arm on my Nash Quad. While I was trying to make repairs of some sort, Fritz polluted the air again, and, as my location was plainly marked by a gang of French artillerymen smoking cigarettes, the Hun did not lose much time starting the racket. Naturally, while the Boche was lambasting the pike, I was peacefully dying of fright about one hundred yards off the road where someone had thoughtfully dug a shell hole for me.

It was no uncommon experience for a truck driver to engage in a game of wits with an enemy artilleryman, whose shells kept bursting at intervals of fifty to one hundred yards in front and to the rear of the truck.

It was a grim game.

The German artilleryman's problem was, What speed is that chauffeur going to make before the next burst?

The chauffeur's problem was, What speed does that artilleryman think I'm going to make before the next burst?

If the artilleryman outguessed the chauffeur, he got the truck—and perhaps the chauffeur.

If the chauffeur outguessed the artilleryman, he got away.

CHAPTER XL

"NACH BERLIN!"

BRIEF are the cycles in which Fate disposes of dynasties. The tide had not merely turned: it had begun to sweep backward in the direction of Berlin. And this backward movement had its inception at the very stream whose banks the enemy, with the triumphant "Nach Paris!" on his lips, was crossing less than two months before. And now here he was, with rapidly crumbling morale, surrendering in huge droves or retreating toward the Vesle as rapidly as Ludendorff's carefully conducted movement to the rear would permit.

If we look for an intimate picture of the part the telephone played in following up the retreating Hun, we find none better than that furnished in the official report submitted to the Chief Signal Officer of the A. E. F., by Lieutenant John H. Pearson, formerly of the Plant Department, New York Telephone Company, Manhattan-Bronx Division:

I was commissioned 2nd Lieutenant on July 9, 1918, and on July 21 was assigned to the 406th Telegraph Battalion, 1st Army Corps.

Arrived at La Ferte, Sous Juarre, on the evening of July 23rd, and realised immediately that I was approaching the fighting zone. The railroad station had been demolished by a perfect hit from a hostile plane, and there was considerable troop movement on the road to Château-Thierry. Upon reporting to the Major of my battalion, I was ordered to be ready at three o'clock the following morning, to leave for the P. C. of the 42nd Division.

In the morning, after a speedy journey by auto, over fair roads, I arrived at Picardy Ferme, where the P. C. was located, and enjoyed the thrill of witnessing a perfect sunrise over a beautiful section of France, which had just been laid waste by the Hun and our pursuit.

The exchange was located in the cellar of a demolished building, which had no roof, but over which several protective layers of sandbags had been placed. This building, like all houses thereabouts and the country itself, showed plain evidence of the recent occupation by the German troops, and the battle which was waged in driving them out.

In one dugout, which had not been disturbed up to the time I reached it, was a German officer sitting in a chair, with a small wire reel in his lap, the wire running through his fingers. He had been in the act of paying out the wire, when one of our shells apparently caught him squarely in the head.

An officer of our battalion was already stationed at this point, as Liaison Officer with the 42nd Division, and was waiting for word to jump ahead with the new advance P. C. All of the officers on duty there were sleeping either out in the open, or in cars which were well camouflaged from the enemy.

The job of establishing the new P. C. was given to me, so that at about noon of that day I was shown the objective, on the map, and the probable location of the P. C., and with a section of about sixteen men, awaited the word to lay the wire and establish communication to that point.

Received the word to go at about 3 P. M. and immediately set out to pick up the existing circuit at a town several kilometres northeast. From that point it was necessary to lay a new circuit to the southeast, east and north, for a total distance of about eleven kilometres to the town of Trugny.

After a two hours' trip over badly congested roads, arrived at the point where the circuit was to be tapped on, but experienced an hour's delay in locating it, so that there was left only two and a half hours' daylight in which to lay the eleven kilometres of wire.

From this point, our one and a half ton Packard truck, with the mile reel of field twist spinning on a bar, which straddled the rear end, started over a fair road, making good progress. The wire was paid out over the tail gate, with a number of men following up to place the wire free from the road and provide the proper clearance at roads and other crossings.



U. S. Official

A FIELD SIGNAL BATTALION SWITCHBOARD

In operation in the St. Mihiel salient. The American equipment was enriched with several hundred miles of German wires captured in the clean-up and a number of telephones. One of these telephones, stamped with the German eagle, appears in the background on the wooden table.



U. S. Official

ENEMY STUFF

Lieutenant-Colonel R. D. Garrett, Chief Signal Officer, 42nd Division, testing a captured German telephone.

After a short run, it was necessary to turn east on a road which was not only badly torn and had quite an up-grade, but was also alive with troops and vehicles, thus making it very difficult to proceed with the truck.

Stringing wire in this manner, under ordinary circumstances, means quick work, but under conditions such as were encountered here, the work proceeded very slowly. In meeting an obstacle in the road which it was impossible to pass on the side on which the circuit was being laid, it was necessary to throw the wire up and over the obstacle, which, with the oncoming darkness, increased the delay and chances of poor transmission in the circuit.

In making the last leg of the journey, north to Trugny, the worst difficulty was encountered, and it was thought necessary to unload the reels and load them to some point where they could be jacked up and the wire paid out in either direction. Troops were being replaced at this time, and besides the infantry moving in both directions, artillery and truck trains moving forward, and wounded being moved to the rear, the road was being harassed by machine gun fire and troop bombs from hostile planes, and was being bombarded by the enemy's artillery.

At about 10 P. M., just half an hour before the Commanding General of the Division was due to arrive and demand communication, our circuit was cut into a camp telephone mounted on the last empty reel, at Trugny, and a turn of the crank immediately brought the operator of the rear echelon to the other end of the line.

Pending the arrival of the Signal Officer of the Division, to whom I was to report at this point, the day's work was done; and it was indeed with a sense of glorious satisfaction that I answered calls on that single camp telephone, where, a few hours before, our boys had been fighting a bitter hand-to-hand battle with the Boches.

The town of Trugny received considerable attention from the Boche guns and planes during the next few days and nights, so that our men were sent back immediately, while another officer and myself, together with two motorcycle drivers, billeted under a tree just off the main road. On their way back that night, our men were attacked by Boche planes, and although bombs landed within thirty feet of them, killing some men and horses, and there was considerable machine gun fire, none of the men of our battalion were hit.

The field in which we slept was a sort of dead man's land

between those actually fighting and those waiting to get into the fray. Dead men and horses were strewn over the fields and roads, and as all other troops had moved either forward or to the rear, and we were shelled continuously during the night with plenty of gas and high explosives, it was an extremely lonely and gruesome night, spent with no sleep and with the nervous tension always at the breaking point.

The following two days and nights were also spent at this point, though by this time the artillery had moved up, one battery being located about two hundred yards to the rear, and another about the same distance forward. During the second day our work consisted mainly in dressing up the tangle of wires, such as generally accumulate during a rapid advance. After completing this work, I moved back with the other company of the battalion.

In moving about and between the various sectors, I have frequently handled truck trains in areas subject to observation by the enemy, hauling Signal Corps supplies, ammunition and wounded, for long periods over strange, treacherous roads, during all sorts of weather, and without lights of any kind during the darkest nights. On this duty, the chauffeurs and lookouts of this battalion did noble work, unflinchingly, being on the road for one period of sixty hours without sleep, and for almost as long a period without coffee. At times, being on a return trip from hauling supplies or ammunition up forward, our trucks were commandeered by the hospital, for hauling wounded.

After P. C. has been established and new territory is taken it has been my duty in the Château-Thierry sector, to make a survey of existing telephone and telegraph facilities in the Corps Area. The field to be covered extended generally from the P. C. of the Corps to as far forward as it was possible to go without being picked off by the enemy. Needless to say, this work was very interesting and offered great possibilities for seeing the different phases of warfare, and all phases and stages of communication. At times, I was among the more sturdy open wire lines brought up by the army, and at other times pretty well forward where only field wire was used, it being laid loosely on the ground, or placed on stakes in the trenches or stakes occasionally in the fields where it was screened from enemy view.

And later, Pearson relates, to vary the "monotony" of telephone work amidst the dead and the wounded, ducking

Boche bombs as he picked his way, he was sent to locate and bring back to his battalion (the 406th) a chauffeur who had started out three days before with a load of wire and had not been heard from since.

On account of the activities in this sector, it was believed that his three-ton truck had been taken off the road for hauling wounded, as it was known that his first duty had been performed. After a search of a day and a half, I located him in a valley which was impassable to vehicles. There were also two ambulances loaded with wounded, which had been there for a day and a half. All were in pretty low spirits, as their food had run out and it was pretty cold.

After locating the caterpillar tractor belonging to a nearby division, I managed with the aid of an engineer officer, to get the two ambulances out of the mire and on the road, and then towed our own truck out and back to the battalion.

The chauffeur had a three days' growth of beard; had had very little to eat, and had lost most all of his equipment trying to get help. He was in rather a joyful mood, however, upon seeing his battalion again.

"After the Battle of Amiens," according to Frank H. Simonds,[1] "Ludendorff advised his government to make peace. To the present writer Marshal Foch once remarked that after this day Ludendorff's single resource was an immediate retreat, a far-swinging retreat like that of March 1917. 'Had he done that,' said the Marshal, 'he would have made me a great deal of trouble. But when he chose instead to go back little by little'—and the Marshal waved his hand back and forth rapidly—'I had him.'"

Not the least of the difficulties Foch had in mind, would have been those involved in maintaining signal communication.

What would have happened, for example, had the Ger-

[1] "History of the World War," Vol. V, p. 210. The Review of Reviews Company. Copyright by Doubleday, Page & Company.

mans, of their own free accord, decided to fall back upon the Rhine, destroying, as was their custom, all telephone and telegraph lines left behind them?

The answer is: We would not have had enough equipment to make it possible to keep up with them.

We might have brought into requisition the multiplex printing telegraph, whose extraordinary fertility in handling traffic might have partly filled the enormous gap. Possibly, too, we might have torn down existing French lines in the backward areas for emergency use.

But what a territory to be covered in a relatively short space of time! When we consider the gigantic total of poles, wires and equipment necessitated by American Army activities in the limited fighting areas of eastern France alone, and the length of time it took to wire this segment, we may congratulate ourselves that Ludendorff failed to appreciate the strategic value of a wholesale retirement which would have rendered it well-nigh impossible to consolidate the territory, from the standpoint of communication, with anything like the thoroughness essential to a safe advance.

All this points to the obvious need, at the time, for a speedy, flexible system of telephone and telegraph communication, exceeding in mobility anything so far developed by the Allies; and this, apparently, is a thing General Russel had not overlooked.

Not many, except those immediately concerned, are aware that the American army in France had a group of fully equipped telephone and telegraph offices on wheels, capable of being shifted back and forth with the rapidly changing army headquarters by the simple process of cranking up the motor.

It was the first time such a thing had ever been done in the field of wire communication.

When Colpitts, of the Western Electric Company, returned from abroad in December 1917, one of the matters that he took up on this side of the water, at the instance of General Russel, was that of designing portable telephone and telegraph central offices. The idea, as stated, was a wholly new one. It seemed a trifle visionary, especially in view of the immediate requirements of the campaign.

And yet Russel had strongly urged it as very desirable in case it ever became necessary for the commanding generals of the armies to move their headquarters suddenly from one point to another, and there were enough optimists in the American army to believe that that day was not distant.

The matter was turned over to the Western Electric Company, and design of the apparatus was begun at once. Before long, the construction of two complete sets of telephone apparatus, mounted on large automobile trucks, was under way.

This was the genesis of the equipment finally referred to, in official Signal Corps terminology, as "Mobile Telephone and Telegraph Offices."

The telephone office contained a 5-position magneto multiple switchboard, and was practically as complete as any ordinary telephone office of its size and capacity. It was an interesting looking outfit, mounted on an automobile chasis of 5-ton capacity,—sufficient in size to accommodate full switchboard equipment, wire-chief testing cabinet, and all the other paraphernalia that goes with a telephone exchange of similar size. The power plant was directly driven from the automobile engine, and supplied current for the necessary storage batteries, ringing generators and lighting.

The telegraph office, in outward appearance, resembled the telephone office, the same type of truck and body being used. The office was equipped with eight operators and one supervisor, and the truck contained a storage battery of sufficient potential to furnish line current to all the lines radiating from the telegraph office. The power plant for charging the storage batteries, like that for the telephone office, was in the truck engine, thus making each office complete and entirely independent of any outside source of power.

Here again we have an illustration of the interesting way in which the different groups of telegraph and telephone experts, all of them closely related, professionally, in civilian life, and now scattered from factory to firing line at various points along the whole front, contributed their joint effort to produce the final and perfected result. The first portable telegraph office was designed and built by the Research and Inspection Division, with the co-operation of the Engineering Division of the Signal Corps at Tours, France. This office was equipped with dry batteries, and was worked out in line with the original plans suggested by General Russel to Colpitts shortly before the latter returned to the States. In original tentative form, its design was mapped out by Howk, whose efforts in the A. E. F. we have previously traced. Subsequently the Research and Inspection Division worked out the details, and actually produced the outfit complete by June, 1918.

The second portable telegraph office was built in the United States by the Western Electric Company at its Hawthorne plant, in accordance with the design of the Engineering Department of that Company in New York City. It was originally built for telegraph operating by hand, instead of by

typewriter, and was slightly crowded. It had an excellent power plant. It no sooner got to France than the former Bell engineers then associated with the telegraph end of the Signal Corps game under Frank H. Fay, took it and had it modified so as to accommodate it to A. E. F. practice, especially in the matter of the use of typewriters instead of hand operating, and by concentrating the lines, so that more capacity would result.

But that was not all. Out of this single outfit intended as one telegraph office by the Western Electric Company, Fay and his group constructed two separate mobile telegraph offices. The outfit had arrived in France some time in August, 1918. It had not only an excellent power plant, but also a tender-truck attached to it, intended as a safety factor for the power supply. Out of this tender-truck, these engineers under Fay constructed a third mobile telegraph office, complete in every respect, and this mobile telegraph office was sent to the front one month after it had arrived, as a mere tender-truck, in France. It was this same mobile telegraph office which later went to Germany, and for quite a time served as the sole American telegraph office in Coblenz.

Clarke, at the telephone end, did somewhat the same thing with the mobile telephone office sent to France by the Western Electric Company. That, too, was accompanied by a tender-truck for extra power, supplies and spare parts. This tender-truck was sent to Gievres by Clarke at the same time that the telegraph trailer was being re-designed by Fay, and out of this tender truck a complete mobile telephone exchange emerged, nicely adapted to the immediate needs at the front.

It is due in large part to mobile and ready-to-hand devices such as these, that the American Signal Corps failed not in

its task of maintaining communication at every stage during which the Allies trod close upon the heels of the retreating foe. But the larger significance lay not in these devices at all, but rather in that superb organisation built up by the Chief Signal Officer,—an organisation whose constant energy and foresight merely reflected its leadership.

CHAPTER XLI

AISNE-MARNE TO ST. MIHIEL

WHILE the American Army was making history in France, what, in the meantime, was happening back home?

We have seen how, following the great German drive in Picardy, Lloyd George's appeal for American reinforcements in the latter part of March, 1918, was answered during the next four months by a transatlantic crusade of nearly a million troops, many of whom were on their way to the front within three weeks after landing in France. And we have seen how these numbers permitted Foch to stem the onrushing German tide and turn it in favour of the Allies.

The campaign was gathering momentum at home as well as overseas. August 23, 1918, had been set aside as the registration date for those who had become 21 since January 5, 1918. The second draft had already gone through. The third registration for a draft, which was to call upon the male population of the country between the ages of 18-20 and 32-45, had been scheduled for the 12th of September, 1918. Three successive and more than successful Liberty Loans had been floated. The Fourth Liberty Loan was scheduled for the latter part of September. In short, behind the American Army in France, the entire American people were forging ahead full blast.

The part played in this mighty effort by the telephone and telegraph systems of the country has already been traced in

detail. Colonel Carty was now on his way overseas. He had served as an important connecting link between the nation's military establishment and the tremendous reservoir of energy that lay in its wire communication system. He was now about to join the rest of "his boys," whose efforts under General Russel's leadership had resulted in a military telephone and telegraph system without parallel in world history.

Carty's overseas orders meant that the Chief Signal Officer of the Army was now satisfied that the nation's wire resources had been fully mobilised. He had drawn to his staff, under able executive direction, an admirable personnel representing technical talent of the highest order, not only in the immediate field of wire communication, but throughout the entire field of electrical engineering. Twelve expert telegraph battalions, including the most highly trained personnel available in the Bell System, together with two companies of electrical experts from the Western Electric Company, had been marshalled together with equal care and dispatch, setting an excellent example of preparedness. The nation's enormously increased war activity had been provided for by a multiplication of long distance and local telephone facilities which strained every fibre of the telephone and telegraph organisations of the country, depleted as they were by a wholesale exodus of trained personnel donning the khaki and the blue. It was all a magnificent effort, magnificently conceived and magnificently executed.

Carty sailed on July 18, 1918, arriving in France on July 30th. Two days later, the Postmaster General of the United States, Mr. Burleson, succeeded in having transferred to his Post-Office Department, the enormous telephone and telegraph systems of the country, on the ground that such a

step was required by military necessity. Prior to the war Mr. Burleson, in his annual reports as Postmaster General, had repeatedly urged the step on the ground of economy, as originally argued in Congress by David J. Lewis. The latter was now made a member of a Post-Office Committee created by Mr. Burleson for the administration of the telephone and telegraph affairs of the country. It was a step which the Government was to retrace precisely a year later when, on August 1, 1919, the telephone and telegraph systems of the country were handed back to their former managers.

As Carty stepped ashore at Brest, he was greeted by a naval officer, who saluted and said, "Sir, I was sent here as Admiral Wilson's representative to receive you."

Carty had to look twice before he recognised, in the nattily clad young naval lieutenant before him, the familiar figure of one of "his boys" from the West, V. E. Cooley, of the Pacific Telephone and Telegraph Company. Cooley had been attached to the office of the Director of Naval Communication at Washington, under Lieutenant Commander Lee Jenney (of the American Telephone and Telegraph Company), when a cable was received from Vice Admiral Sims in London asking for a Reserve Officer commissioned from the Bell System, to be stationed at Brest. Cooley was charged with looking after the telephone needs of the Navy in France, closely co-operating with General Russel's Signal Corps organisation, which included many of Cooley's former associates.

Following the great turning of the tide along the Aisne-Marne on July 18th, American troops practically withdrew from active fighting for over a month. There was no pressing emergency calling our troops at the front. The Germans

had not recovered from their reverses at Soissons, the Champagne, and the Marne. And now, as the British were launching a new attack against the German salient near Amiens, Pershing was bringing to realisation what he had long been planning, viz., an independent American Army unit, separate and distinct in itself,—American troops fighting solely under American commanders.

If, in the meantime, we follow the British at Amiens, we find familiar faces.

The 412th Telegraph Battalion, from the Southwestern Bell System, had been assigned as Corps Telegraph Battalion upon the formation of the 2nd Army Corps in April, 1918, and when the latter was assigned to fight with General Haig, the boys from the Southwest found themselves along the British front.

Preparations for the drive in front of Amiens went forward with the utmost secrecy. On July 28th, Company E of the 412th moved to Oisemont for construction work. "We were certainly puzzled," writes the Battalion historian; "we were running up a pretty substantial telephone and telegraph line, and its destination seemed to be the middle of a field, miles from any town. No stretch of the imagination could develop an answer for its being. We learned later that the British had prepared a feint to the north, and that King Albert of Belgium, hearing that a big show was coming off in Flanders, near his own front, indignantly demanded why he had not been informed. A few days later, we got an idea of what was coming off. There was a railroad siding near the open field to which we had run our line, and one morning the answer was provided by the presence of Marshal Haig's train with lines stretched out to the permanent construction."

The attack, which came off on August 8th, was a complete

surprise, and its success was immediate and complete. Of that date Ludendorff wrote, in his account: "The black day of the German Army in the history of this war. This was the worst experience that I had to go through."

In the drive which followed, from Amiens to Roye, Company E of the 412th built the permanent lines for the British 4th Army, and several weeks later Company D moved to Houtquerke, Belgium, where the 2nd Corps Headquarters was established. Here Company D took over the entire system of communication from the British Division.

While this action was going on at the British front, comparative quiet prevailed along the Marne sector. Our friends of the 406th (Pennsylvania Bell) Telegraph Battalion had moved on to Fere-en-Tardenois, and although by no means idle, were enjoying what, compared to the strenuous days of the Aisne-Marne offensive, amounted to a period of rest. The places vacated by them were taken by the men of the 411th (Pacific Bell) Telegraph Battalion, who reached La Ferte, headquarters of the then forming First American Army, on July 29th, and immediately began installation of switchboard and other equipment to care for the large headquarters. They also began surveying, staking and digging holes for a toll line from La Ferte to Château-Thierry, and early in August a detachment of one officer and eighteen men was moved to Château-Thierry to install a switchboard and telegraph station in that memorable town.

"On August 6th," to continue the official record of this Battalion, "the balance of one company was moved to Château-Thierry, where they were engaged in the installation of telephones and the building and maintaining of lines to 1st and 3rd Corps Headquarters. On August 9th, Company E and Headquarters moved to Château-Thierry, and at once

engaged in surveying and laying out contemplated toll line routes from Château-Thierry north to Fére-en-Tardenois and Coulonge. Part of the plan involved using abandoned German pole lines in this territory and French leads along the railroad from Château-Thierry to Armentieres.

"However, just as this work was under way, orders were received to move the entire battalion to Neufchâteau."

This was part of the great troop movement to the Toul sector in preparation for the St. Mihiel offensive. The First Army had officially begun functioning on August 19th, with headquarters at Neufchâteau. This meant new telephone facilities on an extensive scale. The Pacific Battalion was immediately put to work on installing telephone facilities at the new headquarters, including three sections of switchboard, sub-station equipment, and the like. A 16-wire line was built from Toul to Saizerais, a distance of approximately 15 miles. A similar line was built from Void to Ligny-en-Barrois, a distance of approximately twenty miles. A 32-wire line was built from Ligny to Willeroncourt, a distance of approximately five kilometres. Wire was strung on existing French leads, existing American pole lines were strengthened, additional circuits placed thereon,—in short, a complete network for the First Army area was built up from existing lines and new construction wherever necessary.

In this work the 401st (New England Bell) Telegraph Battalion, which had been added to the units of the First Army Headquarters, worked side by side with the 411th: representing East and West, Atlantic and Pacific coasts, respectively.

During the remainder of August and the early part of September, while these battalions were busy every minute of the time in establishing, operating and maintaining the

First Army network outlined above, preparations for the Big Show were being made by every unit of the American Army.

For, with the approval of the French High Command, General Pershing was planning the doom of St. Mihiel.

CHAPTER XLII

ST. MIHIEL

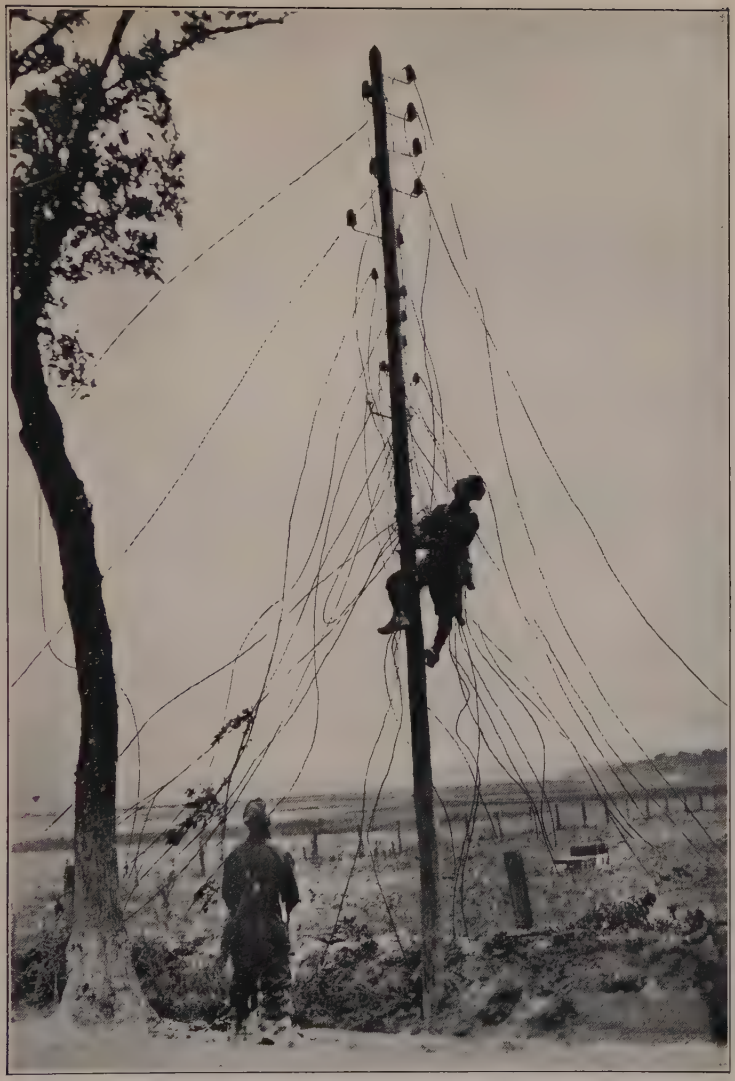
On September 12, 1918, the First American Army, under the immediate command of General Pershing, attacked one of the most stubborn enemy positions on the western front, and in the course of 48 hours succeeded in pinching out an enemy salient of four years' standing.

The action has since been cited as a model of technical perfection, exhibiting a quality of organisation that has earned the warmest praise from French and British experts. And of this superb organisation the Signal Corps, naturally, —since it was the nerve system of communication for the entire army,—was the vital agency. From start to finish it played a rôle as dramatic as it was of paramount importance; and its official account of the action gives us a singularly clear picture of what it meant to carry this action off so brilliantly.[1]

Let the reader imagine himself seated in an observation balloon behind the sector, on the Allied side. He sees a huge right angle of which the little town of St. Mihiel is the apex. On the lower line are two American Army Corps, the First on the right, the Fourth touching it on the left. Up the other flank is another American Corps, the Fifth. A maze of telephone and telegraph lines tie all three to the First Army Headquarters below Verdun.

It required haste, as well as accurate work by the signalmen, to knit those communications into a working whole. The First

[1] Report of the Chief Signal Officer to the Secretary of War, 1919, pp. 442 ff.



"TROUBLE"

A typical jangle of telephone wires illustrating some of the vicissitudes of war encountered by the telephone repairman.



U. S. Official

ON DUTY AT ST. MIHIEL

American telephone operators on duty at First Army Headquarters equipped with gas masks and helmets ready for use on a moment's notice.

Corps had taken over the old sector of the Twentieth French Corps, wherein the lines were supposedly models of construction, with everything buried to the depth of 2 metres and with junction dugouts having an elaborate system of cross-connecting frames and test panels. Apparently everything was ready for the jump-off.

Closer investigation proved the contrary. The French, years before, arranged the circuits for an offensive, but plans were changed into a defensive and the lines had been left practically the same. Circuit records had been lost, so that the first task of the Americans in taking over the area was to place every qualified officer and man at the duty of tracing lines. The next step was to complete the necessarily new lines to four divisions, to balloon centres, and thence to the many artillery groups. Twisted pair was built into ramebas and caniveau, while open wire circuits were strung throughout the rear areas.

A heavy storm occurred just before the army operation was to begin. There came into the corps telephone office a deluge of complaints that lines were grounded in all parts where wires had been buried. At first the pot heads and terminal boxes were thought defective, but it soon appeared that the fault lay in the cable itself. A disintegration due to the soil chemicals caused the circuits to become useless when the rain soaked through. A large part of the telegraph battalion had been working for the First Army and was not available. However, signalmen rectified the trouble.

Passing to the left, we find two signal units of the Fourth Corps equally absorbed in preparations for the Big Show.

The Four Hundred and Fifth Telegraph Battalion[1] was engrossed in making a cut-over to the new 80-drop switchboard in the corps command post dugout near Menil-la-Tour, on the outskirts of which the first echelon had established its command post September 10th. It had been decided to run three alternate routes from Menil-la-Tour to the starting point, and, to prevent serious interruption, signalmen were placed in groups of three along the main axis at short intervals of 1 kilometre.

An officer in charge of each group of six repair stations was connected to all of them by a telephone circuit on the same route, so that any break would sever his own command line, and thus give him a signal by which the trouble could be located quickly.

[1] From the Mountain States Bell Group.

Another line was connected to all group commanders for the same purpose.

The spirit of the men was unshaken as is shown by an incident in the streets of Nonsard. A shell burst in the centre of a construction gang, killing two and wounding two others. One man who had been tying in wire at the top of the pole was struck by fragments three times, but he finished his work before descending to be taken to the hospital.

Working with the Four Hundred and Fifth was the Three Hundred and Tenth Field Signal Battalion. Distribution of personnel was based on a plan employed by long-distance companies in the States. On September 11th the whole battalion was divided into platoons, with a section of line or cable assigned to each and a system which paralleled that used by their partners, the Four Hundred and Fifth Telegraph Battalion. A test station established at each interval of half a kilometre was manned by one operator, one lineman, and one relief man. Each station was to answer roll call every five minutes during the night, and the lineman was to walk his section once each half hour. Extra maintenance details lay behind walls on the outskirts of shelled towns, ready to rush out to a break, run in a new pair, and close the gap.[1]

Let us interrupt the Chief Signal Officer's narrative a moment with the account of one of the officers immediately in charge of this particular bit of signal activity. As told by Captain Enoch R. Hannibal, of Company E, 405th (Mountain States Bell) Telegraph Battalion:

Things were fast shaping themselves to some definite account as we took over the French lines early in September, 1918. The lines were a hopeless tangle. Under ordinary circumstances they would have looked like a good month's job. As it was, we knew that we had but a few days in which to complete the work. With feverish haste, with the hardest kind of work, we were able to unweave that terrible tangle of French lines, adjust them to our need, and, in addition, build auxiliary lines, besides installing the exchange at the Corps Headquarters and the new underground establishment at Menil-la-Tour.

[1] The reader will be interested to look back, for a moment, to Chapter III, page 30.

On Sept. 9th, the Battalion was divided into platoons, each in charge of an officer. To each officer was assigned the duty of maintaining a certain section of the corps axis of communication. The portion to which I was assigned was in the dense woods between Sanzey and Audanville. A portion of the line was in open wire, a portion on stake lines, and a portion on trees. Through that dense underbrush, with line after line of barbed wire entanglements half hidden by foliage lying across our path, it was difficult enough to follow the line in broad daylight; at night, it was next to impossible. We worked at it incessantly day and night.

To make things worse, it started to rain and continued to rain until the evening of September 11th, when a strange hush seemed to settle over everything, and the lines of communication which had been fairly singing with messages suddenly became almost completely hushed.

It was the calm before the storm, and there was little sleep for the Signal Corps men in those wet woods under the shelter of pup tents, ready to shoot the first case of trouble. The hours dragged until finally it seemed as if nothing was ever going to happen; but at 1 A. M. it seemed as if the very lid of the earth was being blown off with the mighty bombardment that was to blast the way for the Divisions in the trenches.[1]

Fortunately for us, there was no answer from the enemy; and at daylight we broke camp in the woods, returned to our headquarters, and boarded the construction trucks for the work of carrying the circuits forward. That afternoon and night eight circuits of twisted pair wire were strung from Ausanville to Flirey, about six kilometres, using such natural supports as could be found, and lance poles where there were no other supports.

The use of lance poles recalled to my mind a statement made by General Russel when we first arrived in France. After inquiring if we had had practice with lance poles in the States, he remarked, "Well, some day we will get the Boche on the run, and then your lance-pole experience will be useful!"

The stringing of the circuits to Flirey and the establishment of the advance P. C. at that point in a dugout under the wrecked

[1] "Five minutes before the barrage began," relates John W. Argo of The Bell Telephone Company of Pennsylvania, "the darkness was so intense that you could find your way only by holding to the man in front of you. Ten minutes later you could read a newspaper by the light of the gun flashes."

railroad bridge allowed us such rest, after a 40-hour trick, as could be derived from the open, rough, shell-pocked ground, soaked by several days' rain. Already the roads were impassible for traffic, except the lane kept open for ambulances; and the condition of the road north of Flirey was such that not even a motorcycle was allowed to pass. But still the line of supplies came. At daybreak we were ready to go, but our trucks, fitted and equipped with infinite care for rapid wire-stringing, were tied up in the traffic jam; so there was only one thing left to do to get the wire forward, and that was to carry it. Four circuits were thus taken forward that day over No Man's Land, to a place called Essey, 5½ kilometres beyond where a switching point was established. Branches were run out to Pannes, 3 kilometres beyond, and to Euvezin, 2 kilometres to the east.

It was heart-breaking work. There was no time to eat, and rest was out of the question. During the day, approximately 35 kilometres of wire had been strung, every foot of it being carried from 1 to 8 kilometres.

The four circuits could not carry the load imposed upon them, and I was given orders at 5 P. M. to string four more from Flirey to Essey, and not to stop until they were completed. So we started back once more to carry out the order, though the men were almost at the limit of their endurance.

All the pitch-black night we strung wire over the desolate waste of No Man's Land. How it was done I do not know, but it was one of those typical examples of the power of the will to do, the power that turned back the tide that threatened to destroy the world.

The trucks were now able to come through, so upon the completion of the four circuits, a temporary camp was chosen in a field north of Flirey, and after providing the men with food and hot coffee, they were given the opportunity to take the much needed rest they had earned. That was Saturday, September 14, 1918. Since Monday the men had been under constant strain with little rest, and twice they had put in tricks of 36 hours each at the hardest kind of work and with little food. The shells that dropped that night in the immediate vicinity had little effect in arousing us from our well-earned sleep.

Let us resume the Chief Signal Officer's narrative:

Along the flank nearest Paris, was the Fifth American Corps, with the Fifty-fifth Telegraph Battalion[1] and the Three Hundred and Seventeenth Field. All personnel of the two battalions, however, was pooled, and when line material arrived on September 1st for the construction of the corps axis and the artillery telephone net, two general working parties were formed, each with a definite area to prepare. Corps Headquarters was then at Benoitevaux. Telephone stations were installed and operated at 17 major points. The Fifty-fifth and Three Hundred and Seventeenth together strung nearly 300 kilometres of wire, most of which was on ground stakes, either in trenches or above. Limited time and difficulty in obtaining poles necessitated this construction. When the corps command post moved up to Ancemont on September 10th all lines were cut in and service was furnished until the end of the drive.

One of the most difficult undertakings was the digging of a trench 6 feet deep and 1 kilometre long to hold a 21-pair lead cable that was to connect to the Twenty-sixth Division at Sommedience. For three days and two nights the signal men had one piece of bread and one cup of coffee at a meal each. There was no rest. When a man fainted from exhaustion his comrades worked the harder, and even the officers in charge wielded picks and shovels with them. Captain Roy Bowland operated a switchboard for hours. The hill was a ledge of almost solid rock, and practically no explosives were available.

Through a stroke of good luck the 406th (Pennsylvania Bell) Telegraph Battalion, on the day prior to the St. Mihiel assault, secured information of the highest military value concerning the German wire system.

This information was secured by Major William Gauss, the resourceful Pittsburger of whom mention has already been made on several previous occasions. Gauss spoke both French and German fluently, and was on that account often called upon to serve as an Intelligence Officer for securing information from German prisoners.

[1] Commanded by Major William H. Fairbanks (of the Pacific Bell Group), former Adjutant of the 411th Telegraph Battalion.

W. M. Dixon, Superintendent of the Pittsburg Plant Department for The Bell Telephone Company of Pennsylvania, at Pittsburg, writes the following:

It was just one day before the St. Mihiel assault, and the writer was passing an old shed, when his attention was arrested by the sound of an argument from within. On appearing in the doorway, there sat Major Gauss with a stack of maps on the desk in front of him. Facing him was a German prisoner who was standing at attention like a statue, while the Major was trying to get some information which Bill had a hunch would be of use.

Bill Gauss had got an inkling concerning some very efficient means of communication behind the German line. The details of this he succeeded in getting from the prisoner, and it was of such importance that after the opening of the attack, and during the first few hours of the advance, the terminal of an underground telephone cable was located, which served for communications to a depth of about 16 kilometres into the German lines. This cable was immediately used by the American forces, and served as an axis of liaison for the entire American front in that sector, obviating the necessity of building extensive communications during the speedy advance.

The part taken by the 406th Telegraph Battalion was, as usual, a prominent one. As told by the Chief Signal Officer:

The Four Hundred and Sixth Telegraph Battalion had taken over all exchanges at Liverdun, Saizerais, Domevre on Haye, Tremblecourt, Martincourt, Minorville, Manonville. Thirty telephone operators and many maintenance men were needed at these points. The rest of the battalion built additional open lines between Saizerais and Domevre on Haye for divisional connections. When the thrust began on September 12th, new lines were strung toward Lironville. The poles for 2 miles of this line had to be cut in the nearby woods. This one job required 80 kilometres of circuit to be run forward from the corps centre at Saizerais.

And in somewhat more intimate detail, Griest, of the 406th, continues the story:

As soon as the direction of advance was determined, Colonel

Voris ordered an open wire line through Lironville to Limy. Light cross-arms with Repp insulators and other material were quickly brought up from Toul, and Murdaugh started his circuits north from Domevre. The work progressed rapidly from Domevre through Manonville to Noviant, because the French poles were still almost intact, but north of Noviant many poles were missing, and after the first kilometre all poles had to be cut from the neighbouring forests and carried through to the congested road. Soon the men were having their mess entirely in the open around Lironville, where for four years all movement had been concealed as much as possible and confined to the dead of night because of the ease of observation from the Boche positions on Montsec.

Although the advance across the sector was so rapid that on the first day Saizerais seemed to have dropped into the S. O. S., there was a little racket along Murdaugh's line. The rainy spell had ceased and airplanes were again active, but greater disturbances were caused by two long-range naval guns near Noviant. These beauties were landing shells on a bridge near Metz, and the departure of the missives almost shook the men from the poles. The roadside and fields were strewn with unexploded hand grenades and other ammunition, and it required constant watchfulness, particularly as to the use of shovels and digging bars, to keep from being hurt.

The participation of the 411th (Pacific Bell) Telegraph Battalion in the St. Mihiel attack, is rendered especially noteworthy by the fact that officers of that Battalion were the first Americans to enter St. Mihiel on the morning of September 13th. The night before the engagement started, Company E, of the 411th Battalion, had been moved up to Rupt, on the other side of the salient, a distance of approximately 10 kilometres from St. Mihiel. The next morning they began the construction of seven circuits into St. Mihiel across what for four years had been No-Man's Land. Thus it happened that Major C. H. Moore, Commanding Officer of the 411th Battalion, together with Captain D. W. Scott, Lieutenant Charles W. Smith and M. S. E. Jordan, were the first Americans to enter that pitiful remnant of a village whose

name has gone down into permanent history. Says Major Moore:

> The civilians who were left in the town were absolutely frantic with joy. Yesterday they were prisoners, to-day they were free. They told many tales of their long exile during German occupancy, and were loud in their praise of the Americans, calling them their Deliverers and Saviours. The food which had been supplied by the American Relief Association furnished almost their entire sustenance. Faded French flags, long buried in the bottom of trunks, were now flaunted from almost every window.
>
> As we made our way out of the village, the members of our advance party met General Pershing and his suite working their way into the newly freed town.

The New England Bell Telegraph Battalion, too, took part in the St. Mihiel action.

"Of the Four Hundred and First Telegraph Battalion," reports the Chief Signal Officer, "one company concerned itself chiefly with the Army Signal Repair Shop, while the remainder of the battalion engaged in the construction of fundamental circuits."

Not the least part of the credit for the brilliant finesse with which the St. Mihiel salient was pinched out in the brief course of 48 hours, is due to the marvellous ease and facility with which the telephone communication at Army Headquarters was handled, and this glorious bit of American history was written by six plucky girls who eagerly jumped at the chance of doing their bit in the fighting area in and about St. Mihiel.

It was the work of these girls that moved Don Martin, veteran war correspondent of the New York *Herald,* who lost his life in France, to observe that the efficiency of the American Army switchboard was "as complete as that of a financial institution in Wall Street. There is no delay.

In dozens of instances, during the severest fighting, in which officers called up headquarters miles away, they got a reply instantly—never a delay. The efficiency of American business methods, which it was hoped would be gradually developed in the war machine, even in the midst of such excitement, has been realised, and that is one of the reasons why the operations went through so quickly and cleanly."

The moving spirit originating the demand for women operators was Colonel Parket Hitt, Chief Signal Officer, First Army. Hitt was from the very start an ardent advocate of the use of women operators in France. On August 18, 1918, two days before the preparations had begun for reducing the St. Mihiel salient, Hitt wrote to the Chief Signal Officer: "In order to obtain maximum efficiency of the telephone central at advance army P. C., I desire to use women operators, to be taken from those especially qualified by their familiarity with frontline work and code station work. I will have the facilities for a small number of these operators at the proposed P. C., and no difficulties need be anticipated along this line."

At once the call went out among the 225 women operators in France for a unit of six operators to serve at the front, and at once every girl of the 225 responded that she wanted to go.

"We were all just dying for a chance to go up forward," writes one of the disappointed ones, "and the mean things would let only six of us go."

It was not an easy thing to make so important a selection.

"In view of the fact," says the Report of the Chief Signal Officer, "that the Army had to handle an immense amount of telephone communication with the French armies on its right and left, with French corps in the Army, with the French group of armies, and finally with General Headquarters, it

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And Helen E. Hill, a New England miss, gives her account of the engagement

We have been playing our little part in this last big salient. One morning we were called at 2:30 o'clock to go on duty and for the next 48 hours I, for one, had only four hours' sleep. We worked 12 hours in broken shifts, the "broken" part being the hard part, since it was very difficult to come home, eat, and get to sleep for only a short while. At the office, which used to be a French dining-room, there is a fireplace which the boys would fill with wood for a nice warm fire and we found it quite entertaining to sit through the night until dawn. There was always a Wire Chief and soldier-operator on duty in case we needed help. I amused myself, also, by swapping stories over the wire with different soldier-operators when they would call in to test the lines. We had to test frequently to see that everything was in readiness in case of emergency. One said his office was underground 40 feet and was very cold and clammy.

You can imagine that there was much excitement among the members of the First Army. The officers were getting no sleep and were sometimes impatient to us, but we kept our tempers fairly well and gave every ounce of endeavour that was in us. Nor did it have a marked effect on any of the girls. One could see the dark hollows under their eyes, but not a change in their usual happy voices. Now, of course, it is over, for awhile at least, and we are all getting our hearty sleep and none the worse for wear. On the contrary, I have gained a whole lot of self-control and patience, and am awfully proud of having had such a real part to play in this great salient of St. Mihiel.

Brilliant and vital as was the part played by these plucky women operators right in the advance zone of combat, we must not forget the part that was played during this and the succeeding major engagements by the male telephone operators in the muddy dugouts down in the bowels of the earth.

Some of these operators, indeed, were so far down as to be scarcely aware, so far as noise was concerned, of the terrific duel going on over their heads. But so far as traffic was concerned, they knew only too well the mighty activity going

on about them. Indeed, it moved *through* them, in a surge of incessant and breathless messages, and they worked until they dropped from sheer exhaustion. Other dugouts were not so far removed from the surface, and the tremendous impact of the guns overhead, adding to an intense, overpowering thud, was doubly deafening.

Nor must we forget the work of the subterranean telegraph operators, clicking away at their instruments in the midst of all this inferno, with no sound of a human voice to relieve the strain. A picture of what these telegraph operators had to contend with is furnished by F. M. Henson, of the Engineering Department of the Michigan State Telephone Company:

> We arrived at St. Mihiel shortly after dark, and at once the entire detachment prepared to get into the fight. As upon all other occasions, our friend and enemy, the M. P.'s, escorted the telegraph operators to telegraph offices nine to twelve feet underground, and here the sound of the howling and bursting shell was almost as loud as on top of the ground. If the doughboys up in the first line trenches were getting it worse than we were, and they sure were, I felt sorry for them, for the shells were coming down as thick and fast as *hail;* not hell, but *hail,* and I mean it. I could hardly hear my telegraph set above the noise. The ground shook and mud fell from the sides and roof of the "telegraph office," but we kept the wire working as fast as it could be worked.
>
> For three days and nights I was on duty, and it seemed as if it were that many months, but finally it grew less violent and as soon as advisable I was relieved and told to report back to Is-sur-tille, and I did, and long after those three terrible days and nights at St. Mihiel I found I was so nervous, that every sudden sound or falling of something, or slamming of a door, would cause me to jump as if I had sat on a tack.

And finally, while we are on the subject of telephone operators at St. Mihiel, we must not fail to give passing notice to the splendid and all-important work done by the telephone operators attached to the artillery units, of whose work

Major Nels Anderson, Wire Chief of Chanute, Kansas, for the Southwestern Bell Telephone System, has this to say:

> The best dugouts obtainable were used for the telephone switchboards, and they were gas-proofed as much as possible; but even at that, it was necessary at times for the operators to use gas masks. God knows it was hard enough to operate a switchboard without the gas mask, but when it was necessary to use them and maintain communication, life became nearly unbearable. It was particularly bad during the St. Mihiel party, where we were unable to get under cover with our switchboards. They were set up in the open, and as we were getting lots of gas, the masks had to be worn almost continually. I would like to put a gas mask on you sometime, and then have you try to talk over a telephone, then make a dash across country for a mile or so with somebody throwing brickbats at you at every jump, and then try to splice a wire. This would give you some idea of the ordinary work which we had to go through with. There are lots of unhonoured heroes among these telephone men who deliberately took a dose of gas, which many times resulted fatally, by taking off their masks in order to get some communication through satisfactorily.

It was all, in fact, a splendid example of Signal Corps co-operation throughout the entire A. E. F. Not much, indeed, was left undone that might have been anticipated. Not many have stopped to consider how General Russel managed to secure such splendid facilities on such short notices for the extended requirements of the First Army at St. Mihiel, and this is a matter which involves a certain amount of dramatic irony. A large part of the signal equipment which aided in the destruction of the enemy salient, was originally designed for use several months back, when fear of destruction *by* the enemy was the order of the day.

It will be recalled that at the time the German advance threatened Paris, a complete duplicate of the American wire communication system in Paris—a knockdown system—was awaiting emergency use at the great supply centre in Gievres,

ready to be rushed to Paris on a few hours' notice in case the Paris system of wire communication should be destroyed by a bomb or long distance gun.

When the First Army came into existence, the first tentative plan was to establish the army field headquarters in the retaken Marne salient. The establishment of an army headquarters involves the construction of a very considerable telephone exchange and telegraph office.

Realising that, with the check which had been administered to the Germans at the Marne, the whole course of events had changed for the Allies, the Signal Corps took a chance and ordered the duplicate Paris installation held at Gievres to be partially shipped to La Ferte for emergency use by the First Army. Instructions covering this shipment were given by telegraph to Gievres, and this shipment, which consisted of approximately ten carloads, was loaded and was moving toward the front within less than three hours. And thus was the Signal Corps enabled to furnish a wealth of telephone facility for the St. Mihiel effort, which proved to be the heart and soul of the marvellous team work displayed in that historic engagement.

* * * * * *

After all is said and done, no description of a military engagement,—neither the studied accounts of students of strategy nor the precise reports of military commanders,—can vie in vividness with the simple, unadorned tale of the soldier, and it is on this account that the story of St. Mihiel, as told by Arthur I. Wissman, a statistical clerk in the Accounting Department of the Southwestern Bell Telephone System at St. Louis, is here told in full. Wissman served with the engineers, and was a battalion sergeant-major at the time of the battle of St. Mihiel:

It was an "excellent" night for a drive, the wind whipping a cold, mean rain that continued steadily without signs of abatement, through an inky black night that defied the keenest eye to see two feet ahead.

All the week before clouds hung low in the sky and rain fell intermittently, making aerial observation on both sides impossible. Every night artillery, tanks and ammunition trucks had rumbled by to get into position for the "jump off," and on this day, September 11, 1918, all thoughts of concealment were thrown aside. Long columns of infantry in single file wound in and out among the stalled tractors and balky trucks, all going up front to get into position before nightfall.

At 8 o'clock this same evening, the Major of my battalion, with eight runners and myself, started "up front" to get orders from the General in Command of the Infantry Brigade which was to have the signal honour of going over the top at 5 the next morning.

Our tissue paper raincoats, buttoned tightly around us and only reaching to our knees, afforded poor protection from this driving rain. We walked about 2 kilometres along a "road" which was nothing more than a continuation of shell holes, mud and slop; and every time Fritz threw up a star shell we would drop flat to avoid observation, as these star shells made a good section of the front visible for fully two minutes. After what seemed about an hour's walk, coupled with 30 minutes of groping and swearing, we found the entrance to the trench for which we were looking. The Metz trench it was called, so named because it followed the line of the Metz road. The entrance was located in a large barn, the Major leading, I trailing close on his heels, and the runners following in single file. We had gone but a short distance when I discovered only two men behind me. A loud whisper brought no response and back I went after the lost six. In the barn I stumbled against them; they were groping and feeling along the walls, seeking the entrance, frantic with haste, fearing we would go on without them.

It was a hike of almost a mile through that trench, in water and mud almost to our knees, loose and rotting pieces of duckboard tripping us. When one man fell, two or three of us would go with him. Falling against the sides of the trench, cutting our hands and knees painfully, climbing out to let larger bodies of infantry pass the other way, then sliding back in, our sense of sight was useless, for all we could do was feel and fall, and the "light" packs on our backs seemed light—like h——!



U. S. Official

DOWN IN THE BOWELS OF THE EARTH

Flashlight taken in a dugout ten feet underground, of a group of telephone operators of the 9th Field Signal Battalion.



U. S. Official

A SPECIAL TELEPHONE INSTALLATION JOB

Dugout in the shadow of a wrecked railway bridge which served as the Post of Command for the 89th Division during the St. Mihiel fight.

When we reached the General's dugout, about 11:30 P. M., I surely was a miserable human. Tired, hands and knees bleeding, soaking wet, mud from my waist down. The exertion had brought out the perspiration all over my body, which made the cootie bites itch like fury.

The floor of the dugout was wet and there was no place to sit down, so I leaned against the wall and waited, while the Major went into conference with the General.

Exactly at 1 A. M., the show started. The sharp crack of a French "75" broke close at hand, seemingly a sort of signal, for hell broke loose the next moment—the noise was terrific. It seemed as though a million guns had been set off. The continual whistle and almost human moan made by the shells overhead, the answering whir and bang as the Boche snapped out of his first surprise, the heavens on the extreme right of the line glowing a bright red from the flash of the many guns, this dying down as the left or centre of the line would flare up, only to flare brighter on the right the next moment—all this, through the steady rain and an otherwise intensely dark night, presented a picture long to be remembered.

And as I shifted my weight from a cold, wet, cramped right foot to a cold, wet, cramped left foot, while leaning against the wall of that damp dugout, I muttered sweetly, "If this is what they call putting over a barrage, they could leave my part out; I'll take the U. S. A. for mine!"

Four long hours that bombardment continued. Four long hours I leaned against that dugout wall. "H"-hour was 5 A. M. With a cheery "Help me up, Buddy; we're goin' over," I saw the infantry leave the trench; a goodly number never needed another "helping over" on this earth—that was their first and last.

At five minutes of 5 A. M. two companies of engineers crawled out to the belts of barbed wire and with bungalore torpedoes and wire cutters made a passage for the oncoming doughboys. Instead of assembling at a given point upon completion of their duties, these engineer companies joined with the infantry in the advance. Forty-five minutes after the boys went over, my Major came up and told me that I was to go with the General and that he, with the runners, would catch up with us later.

A few minutes later the General appeared, dressed for action. After I had greeted him with a wicked salute, he glared at me a moment and then said, "Do you know how to read a map?"

"Yes sir," said I, and visions of being made a shave-tail on the spot rose before me.

"Follow me; hurry up; come on, you men," and the General was off.

My first drive had started. Our party consisted of the General, his Adjutant (a Major), two Lieutenants as aides-de-camp, his personal Sergeant and myself.

The General was small, but oh, how he could walk! Very little map reading I did that day; I was too occupied trying to keep up with that terrific pace, and all the time the General was shouting, "Faster, men; we must hurry! Come on!"

Soon we passed the first American wounded being taken to the rear. With a pat on the head or arm and the greeting, "How are you, my boy?" the General would pass them, at the same time commanding us to hurry up; faster; we must press on! If we had been headed in the opposite direction I'll bet I would have set that General a merry pace!

Now the wounded were more numerous, and here and there the still forms of the dead were seen. Soon we hit the first line German trench and I saw a ghastly sight. A huge Boche was stretched out at the bottom of the trench, headless. Probably the work of a grenade or a clean hit by a shell. Quickly passing from this trench we came to the Germans' second defense or trench. Here the Americans had got in some good work, as the Boche dead were pretty thick.

All the time we were going forward, machine gun bullets whirred past us and shells were falling all around, some too close for comfort. Gas was strong in the air and at one time we wore our masks for five minutes, still pressing forward. Coming to the top of a sort of a ravine we saw before us our first line of infantry just going up the side of the next hill.

And that General *urged haste and pressed forward faster.*

American gas masks, helmets, raincoats and packs were strewn around, showing that the doughboy was travelling light and fast. Various coloured wires along the ground, strung over trees, trenches and shell holes, proved that the men of the Signal Battalions were up in front, keeping up communication with the rear.

At no time did I think of the consequences to myself if one of these shells or bullets should get me. This drive was something new and I was all excited about it. I was, however, fully aware of the fact that I was tired and awfully hungry. It was 2 o'clock in the afternoon then, and the last bite I had had was at 6 the

evening before. I thought it a fine time for a rest and a bite of corn-willie.

But I guess the General thought otherwise, for we went on.

Bunches of prisoners were being marched to the rear. Some were young, white-faced and scared looking; whether from fright or hunger I knew not, and cared less. The badly wounded Germans were carried, sometimes on the backs of their stouter comrades and sometimes in broken, blood-soaked German stretchers. Nearly every bunch of prisoners that passed would contain a few officers, and the General would stop for a few seconds to question them. I was too hungry and tired to pay the least attention to what was going on.

The third-line German trenches were passed. It was quite evident that the Boche had tried to make a stand here, but with poor success. In the trench and for yards behind it, the dead lay but a few feet apart. It is true that many Americans fell here, but for every Yankee there were five or more of the Boche.

We stopped for the first time that day at 5 P. M. My Major, with but four of the runners, had caught up with us, and I felt much better after gulping a hunk of cold corn-beef and a couple of dog-biscuits. He told me that two of the runners had been wounded by shell fire and that he had sent the other two back with a message. It later developed that, of the two men sent back, one was killed instantly and the other mortally wounded by a high explosive shell.

Our stopping-place was along the side of a hill which prevented observation by the enemy. While waiting here, groups of our supporting infantry hurried forward to relieve the tired troops in the lead who had been pressing forward since 5 that morning. I had moved over to ascertain the regiment number of the relieving troops and had just started to address one of the men when several German shells screamed by, lighting just at the edge of our group. I looked up to see the right wrist and hand of one of the men nearby dangling on threads of a torn forearm. A five-inch sliver of "pig-iron" had caught another of the men in the back of the head, going through the helmet and ripping about four inches of skull from the back of his head. He was caught before he fell and first-aid was given both before hurrying them down the hill to the dressing-station. Two more men lay against that hill, killed instantly. I had witnessed some terrible sights that day, but this was beginning to get me.

We had rested only a few minutes when we were ordered for-

ward again. This short rest made us feel our weariness all the more, but we pressed on, faster than before. In a short time we were again on the heels of the fast-travelling doughboys. Hundreds upon hundreds of airplanes were in the air, and it was wonderful to see the darts of the planes a few hundred feet above us, and to hear the angry spit-spat of the machine guns.

By 6 P. M. darkness had set in. Boche shells still burst around us, but the shelling was not as heavy as in the afternoon. My Major was sent on a reconnaissance by the General, and I had to carry his "light" pack as well as mine. My tail was sure dragging. Going through the captured village of Boullionville, we saw how effective our artillery fire had been earlier in the day. Hardly a house was left standing and the road was pitted with shell holes.

As our party clattered through the deserted and debris-strewn streets of this town, a faint light was seen in the hallway of what once was a two-story house. Upon coming nearer we found two old French women past fifty years of age, making their way over the piles of brick, at the same time shielding a flickering candle with trembling hands. When told we were Americans and would not harm them, they burst into tears and exclaimed. "At last, at last; thank God!" They had hid in their cellar that whole day, refusing to go along with the retreating Germans, taking their chances of being killed by shell fire instead. The Boche had been their masters for four years, and when they heard our party coming through the streets, they thought the Germans were coming back, and they were just coming out to give themselves up.

We continued on our way. The road we travelled was thick with overturned wagons, dead horses, and dead Germans. As it was intensely dark again, it was a sort of an eerie march, for we didn't know just when we would step on the face of a dead Boche.

All of the men (and I'll bet the General, too), were intensely tired—just plain all in—and when we reached the town of Thiaucourt, about 10 that night, the General ordered a rest until sunrise. An old, abandoned barn was picked out, and without removing pistol belt or pack, I sank down, rolled over and was asleep before you could snap your fingers. It seemed as if we had hardly been in the place two seconds, when I felt someone tugging at my foot, yelling, "Everybody up!"

I groaned and swore aloud. The General's idea of "sunrise" was 1 A. M.

The showing made by the First American Army more than lived up to expectations.

"The American First Army under your command," Foch wired Pershing, "has achieved in this first day a magnificent victory by a manœuvre which was as skillfully prepared as it was valiantly executed."

The prisoners taken on that first day numbered 14,439, as against an American loss of barely over 4000, including French troops involved. 443 guns were captured, in addition to a vast accumulation of material.

Altogether, the action represents one of the most resplendent chapters in American history.

CHAPTER XLIII

CALL FOR A BARRAGE: ARTILLERY TELEPHONES

On September 25, 1918, an Intelligence Officer of the German High Command reported on St. Mihiel as follows:

> The artillery preparation prior to the attack was well carried out. Their objectives were bombarded with good effect and they were able to switch from one target to another in the minimum time and with remarkable accuracy. The co-ordination between the infantry and the artillery was faultless. If the infantry ran up against a machine-gun nest they would immediately fall back, and very soon new artillery preparation would be directed on that point.

No stronger testimony to the magnificent co-ordination of the various elements in the St. Mihiel engagement could be adduced, than this laudatory comment from an enemy boasting supremacy in military tactics.

The artillery's share in the World War has not, in our opinion, been sufficiently stressed; and the part played by the telephone in making the artillery effective is a phase of the war effort worthy of record.

The Artillery Corps possessed a telephone system of its own, concerning which Major Nels Anderson, Wire Chief at Chanute, Kansas, for the Southwestern Bell System, and during the war with the Field Artillery, has this to say:

> This system did not amount to much prior to the World War, but the new methods of warfare developed a highly refined and

exceedingly important telephone system, with which the artillery officer had to be as conversant as with the batteries themselves.

Everything depended upon the telephone. Observers stationed sometimes as far as ten miles from a battery of artillery directed the firing by 'phone. Practically all orders were sent and received this way. Communication with the infantry, ammunition trains, supply trains, etc., was by telephone, and all such lines connecting with the artillery were constructed and maintained by telephone details from the artillery.

When my regiment arrived in France I was made Regimental Telephone Officer and was sent ahead of the regiment to the artillery training area where I was to take a short course in telephone communication before going to the front. The officers giving this instruction had no telephone experience except that which they had obtained since joining the Army, and their knowledge was rather limited. I found this out after having several tangles with them. I was later assigned there as an instructor.

Considering how absolutely new to the game were many of the men that, perforce, had to be assigned "green" to artillery telephone duty, it is remarkable that they did their work so effectively. But many are the amusing incidents that might be related in connection with putting them through the ropes.

"When I was with the Publicity Department of the Chicago Telephone Company," relates Lieutenant Behrens, in a letter from the front dated September 7, 1918, "I spent some of my time trying to enlighten the public on the use and care of the telephone. I recall some beautiful cuts and copy which dealt with the carbon granules. But alas! I found a soul still floundering in darkness; one who had never read and profited by our instructive pages. He was having difficulty with his 'phone. I found him carefully cleaning the carbon granules. He had them nicely assorted on a paper before him, and was working patiently over them like a jeweller with a delicate watch. I enlightened him and sent him a new in-

strument. I tried to get him a new head, but we were out of them."

Artillery commanders were not slow to realize the importance of obtaining trained telephone men to handle the telephone end of the artillery game, and to train the novices.

"Those pirates from the artillery," complained one commander of a Bell Telegraph Battalion, "are constantly robbing us of our best men, and when we balk, they laugh and say 'C'est la guerre.' C'est la nerve, say I!"

But this eagerness of military commanders to avail themselves of the services of trained telephone personnel did not always argue a readiness to accept their professional advice.

Lieutenant Rutherford[1] and a detachment of men had just completed the installation of the artillery board at the First Army Headquarters at Souilly when Colonel Covington, the officer in charge of artillery operations, entered and inquired how many trunks had been provided between the artillery switchboard and the main exchange.

"Four, sir," answered Lieutenant Rutherford.

"Four hell, I ordered eight!" retorted the Colonel.

"I think four will be ample, sir," ventured the Lieutenant.

"Think hell, I want eight!" said the Colonel, as he slammed his way out of the door.

The door had hardly closed upon the Colonel before it opened to admit Captain Scott.

"Has Colonel Covington been in?" he inquired.

"I'll say he has," meekly responded Lieutenant Rutherford, picking himself out of a corner.

But to resume Major Anderson's story:

The telephones and switchboards which we were using at that time were French. They were big, cumbersome, awkward affairs,

[1] Of the Pacific Telephone and Telegraph Company.

and we certainly hailed with joy the Western Electric instruments and switchboards later received. This Western Electric equipment was simple, light of weight, well constructed, easy to take apart for repairs, and, all in all, a source of joy and a little touch of home for an old Bell Telephone man. It was pretty nearly as good as a letter from home to see the old familiar "W. E." on a telephone.

We received our telephone equipment from the Signal Corps, and, of course, they did not put out anything unless they were well supplied themselves. As a result, you would find all kinds of telephone equipment in an artillery regiment. If we had been able to use German equipment, our active museum of telephone apparatus would have included that, for we captured a lot of it; but German field equipment did not use magnetos for signalling but buzzers, and their sets were quite some affairs—clumsy as all things Germans are—and they required too many changes to be available for our use.

Wire was at a premium. Ye gods! there were times when I would have traded my soul for a few thousand feet of good old No. 17 twisted pair wire, which, for field use, was our one best bet. It was easy to handle, and could be repaired quickly under fire. But the Signal Corps did not issue much of it, as the supply was limited and they wanted it themselves. Any kind of wire was in demand, and we used to have to steal it from adjoining regiments or from the French. The French suffered a lot in this respect. Most any American soldier could convince them that he was entitled to anything which they possessed, but I came a whole lot nearer getting bumped off stealing wire from our own troops than I did by the Boche. All lines were supposed to be tagged every 50 yards, and if you came across a line that was not tagged and you couldn't ring anyone on the line, that was *your* wire. As a result, we lost and picked up lots of wire by the grace of its not being properly tagged.

We first went to the front in the Vosges Mountains. Conditions were ideal there, as the front stayed where it belonged: right in the same place, always. Nice, concrete dugouts for switchboards, etc., and good lines running all over the country. It was the Front De Luxe. It was a shame to spoil it, which is what we ultimately did.

The St. Mihiel affair was a veritable nightmare for the telephone men in the artillery. After the first jump-off we were advancing so rapidly that it was nearly impossible to maintain

communication; and at no time was it more important. We would advance to a new position, and just about the time we had communication we would advance again. It kept up this way for five days and nights. We would lose men and equipment so fast that I wonder we did anything at all. For example, we were always out of wire. We would use German wire, or any old kind of wire we could lay our hands on. When we sent men back to positions we had just vacated for some of the wire we had left there, they would promptly get lost, or get tied up in the jam of other troops coming forward, or something else would happen to keep them from getting us the wire. Sometimes a whole battalion would get lost in the jam, and by the time we had located it, other battalions would have advanced again. It was just a "heluva" mess, but even at that we managed to maintain some sort of communication.

On the third day of this advance, I was right behind the infantry with a party of artillery officers, to check up a new position we were to occupy. I descended into a German dugout into which some doughboy had evidently casually dropped a few hand grenades as he passed, for two of the deadest Germans I ever saw lay there in this place amongst a litter of equipment, out of which I picked up a comparatively new German field telephone, which is now doing duty on my desk.

Not all artillery officers were as fortunate as Major Anderson in laying hold of a souvenir which proved both portable and practicable. At least one officer of the artillery was confronted with the alternative of making off with the town pump, or doing without his souvenir. The quest was not unaccompanied by its thrilling moments, and we will let Captain J. L. Vandergrift, of the Chesapeake and Potomac Telephone Company (formerly of the 341st Field Artillery) relate the episode himself:

To-day I visited the front-line trenches, where I found the Doughty Doughboy in his element of mud and glory—*not for mine.* While there, I was goaded by curiosity to go a step farther to the machine-gun positions, where I crept with caution and misgivings. From the M. G. positions it was but a step to a little village which we had taken over a couple of nights ago.

Primarily, it was my intention to visit this town, but when I viewed the 200-yard chasm across No Man's Land to the first building, I had my doubts about the propriety of such a visit, especially since I had so little business there, and so MUCH business back at the battery. "But," my foolish self contended, "you might find many souvenirs out there." Naturally, my foolish self gained the ascendency and I started. I gained the hedge in safety, scuttled along that, and finally reached its end. The next harbour of safety was a much-shot-at and seldom-missed stump of an apple tree. It was fifty yards distant, looked a mile, but I made it in one leap. While I was volplaning towards it, the tree looked as big as a house. Sheltered behind it, I lapped over on both sides. After weeks, the first building was reached and the town entered. Such a village! Hardly one brick left upon another, and the houses all pulverised. What the Boche had not wantonly destroyed, our artillery had razed for military reasons. Ruins after ruins I entered, but there was nothing left except the town pump, and if you have ever seen these massive things, you know they aren't fit for souvenirs. I returned empty-handed.

For a typical account of an artillery engagement involving the part played by the telephone, we are again indebted to Vandergrift:

The guns were placed and the limbers moved to the road, when the Boche opened up on the road with machine guns. Then occurred a lively (the kind you read about) scene, shouted orders, galloping horses, riders bent low on their necks, and empty caissons hurtling along the road to safety.

At the guns: the bustle of getting "layed"; men hastily digging shallow shelter trenches for themselves and their ammunition; the detail beating it across the terrain running the telephone wires. A pretty snappy sight, especially since there were many shells falling—"imports."

It was merely the enemy's searching fire, for battery could not be seen. By this time we were in action and firing at a dangerously fast rate, at least dangerous to the enemy, whom we could not see, but whose location we knew by the map—that's all one needs to know these days. A few more minutes and every piece of artillery (Allied and enemy) on the entire front was in action, from the sound of things, and the earth fairly rocked.

All was going well with the battery, when it was caught in a

deadly barrage—a curtain of fire. Then the missiles rained; a bit of mustard gas; orders to withdraw the men; safety in friendly shell holes.

This was the sequence during the next hour, and to the shell holes we stuck, for it was suicide even to crawl over the ground. The particular shell hole I was in was as big as an office building. I wished at that time that it were as deep as the ocean. Had it been struck, the only necessary ceremony would have been to have stuck six little wooden crosses in the ground where we were. There were four consecutive duds that hit within a few feet of the hole, any one of which would have done the work had it exploded. Each one in its turn, as it landed and failed to explode, brought forth a fervent "Good Old Dud!" and when three more duds afterward struck just as close, I felt sure that we were spared for further work. This awful strafing continued for two more hours, and for that length of time we didn't venture far from safety. Except for an occasional sniff of gas, the hole was even comfortable, what with a good supply of cigars that I fortunately chanced to have with me.

Another close-up of the artillery telephone in operation, this time in the Coast Artillery, is furnished by H. M. Diffenderffer, also of the Chesapeake and Potomac Telephone Company. Diffenderffer served with Battery F of the 58th Coast Artillery:

We had to run our wires from Regimental Headquarters in an abandoned village, some distance in the rear of our firing position, to Battalion Headquarters, along various roads, across open fields and through woods, stringing the wires if possible on trees. In many cases they had to be strung on the ground, being careful at crossings and damp places to use a light lead cable for their protection. There were many kinds of wire running in all directions for this and that outfit, so we had to be careful in placing our own wires.

Battalion Headquarters was connected with the Battery Commander's station. The former was usually nearer our firing position, but, for its protection, was ordinarily established in a more out-of-the-way location, using the same care in laying the wires as for Regimental Headquarters.

The Battery Commander's station was in an invisible dugout

not far from our firing position. From his station we ran our wires on the ground to a terminal at or near the guns, using a pair of wires to connect all four guns on the same line. Each gun was numbered, and when any messages or orders were issued from the Battery Commander's station, the number of the gun was given, and all other operators were held silent. Thus the sending of various orders to the different gun commanders went forward with little confusion.

Each operator at the gun position, usually a corporal, received at the 'phone his fire instructions, such as elevation, deflection, battery fire or salvo, and repeated them as he heard them, loud enough for the gun commander to hear. He in turn gave the necessary data to his gun pointer and crew for the gun to go in battery.

Each shot had to be reported to the Battery Commander, as, "No. 1 has fired. No. 1 out of order," and so on.

There are two sections to each gun position of 12 men each, so that they can relieve each other when there is night firing. Night firing is hardest, as everything has to be done in darkness, and not a particle of light can be used anywhere near the guns or near the position.[1]

It was a universal lament of the signal battalions that the artillery, with their heavy gun carriages and cumbersome equipment, were everlastingly ripping up their field wire and imposing upon the already overburdened signal troops a never-ending task of maintenance, under conditions involving aggravated risk and hardship. It might have been a source of grim satisfaction to those righteously indignant signal re-

[1] It was to remedy this condition that Lieutenant Colonel Shreeve, of the Research and Inspection Division of the Signal Corps, was called upon by the Ordnance Department for the purpose of designing a device for the lighting up of cross-lines on artillery pieces in such a way as to furnish sufficient light without attracting the enemy's attention. As recorded in a previous chapter, Shreeve went to the front himself, equipped with a pair of scissors and a tomato can, and worked the device out in a dugout. Before long the design was placed on a quantity production basis, so that when the First Division went into line at Montdidier, Shreeve, upon the request of the commander of one of the brigades, loaded a whole car full of his devices into a Cadillac and had them rolled away into action the very next day.

pairmen, had they known that the artillery telephone men upon whom fell the task of repairing their own wires, had troubles of their own in the same direction, though not from the same source. For if the signal telephone men suffered from the artillery, the artillery telephone men suffered from a host of marauders.

On one occasion, an artillery telephone repairman hunting for trouble on a line to headquarters that had gone completely out (with the corresponding parties at both ends naturally aboil), ran across the source of his trouble in a spectacle that made him gasp for breath until he could recover enough of it to do what he considered an appropriate amount of cussing. For there in the midst of a negro encampment, he discovered his precious bit of wire strung up between two stakes and doing duty as a wash line!

A similar indifference toward these vital strands of communication, less in the line of sanitation and more in the nature of outdoor sports, was displayed by the negro construction troops in and about Verdun, where they amused themselves by taking pot shots with hand grenades at the numerous rats in the neighbourhood. The bombs were found exceedingly effective in destroying the rats, but they were equally effective in destroying the telephone lines strung about three inches above the ground.

"As innocent as a lamb" is a phrase which one group of artillerymen, at least, will reject with scorn, especially when the lamb has grown up into a sheep. And this has to do with a target range at LaCourtine, the 63rd Coast Artillery, and a flock of sheep closely resembling goats in the matter of appetite.

The story in detail is related by George G. King, Jr., of

the Pacific Telephone and Telegraph Company, formerly Second Lieutenant, 63rd Artillery:

On one fine clear, frosty day, in the midst of firing, Observation Post No. 8 was reported out of communication. As both circuits went out, it was thought that the trouble was unusual.

It was. The Signal Officer took two side-cars and started to trace the circuit. On arriving at a point where the lead crossed a natural meadow, he was greatly surprised to find a flock of sheep, busily engaged in eating the insulation off the telephone wire. What it was in the covering that attracted their gustatory fancy is not known, but they had removed the insulation from about one hundred yards of wire in a very thorough manner, and had crossed and tangled the circuits so that it was impossible to clear them.

The next problem was how to circumvent the sheep. It would not do to lay more wire while the sheep inhabited the place, for it would only furnish additional relish for these strange animals with a sweet tooth for wire insulation. No poles were available to raise the wire off the ground. Attempts were made to drive the sheep away, but they only returned. We campaigned for an experienced shepherd, but there was none among the detail.

A happy thought solved the difficulty. A battery of the 311th Field Artillery with 75's commanded the hollow favoured by the sheep. A salvo was requested and granted. Driving the sheep as far as possible, the detail took cover. Twelve shells dropped into the hollow with beautiful accuracy. The sheep left. When last seen they were using great energy in getting somewhere else. The Signal Officer was never again compelled to furnish wire insulation as fodder for livestock.

Regardless of depredations for improvised wash lines, destruction by hand grenades, omnivorous sheep and the like, maintenance of artillery communication at all times and under all conditions was supremely essential, and its rupture at any moment might be accompanied by fatal consequences.

The following is related by Lieutenant E. A. Hamilton, of the Chesapeake and Potomac Telephone Company, formerly of the 37th Engineers:

One night I entered a telephone exchange a few kilometres northeast of Montfaucon to call the supply depot. As I got on the line, I heard an agonised voice from somewhere: "For Christ's sake, Captain, don't shoot any more until you get your range; you are shooting hell out of us!" I heard no more of the conversation, but it gave me the "willies" to think how many Americans would have slain their fellows had that telephone line gone out a moment before.

And yet, throughout that entire mess of hardship and hazard that continually hovered over the task of the artillery telephone man at the front, the American sense of humour was not to be suppressed. Just before the big drive in the Argonne, American artillery was moved as close up front as possible, with the natural result that a veritable rain of fire was invited from the enemy. As told by Captain Guy P. Wallick, of the Mountain States Bell (formerly of the 341st Field Artillery):

The Huns had got the range on us, and as it was midday meal time, we were very much disturbed by having those big shells drop in on us, upsetting our mess tables and spoiling our rations. Three times we hurriedly moved to one side, but the shells followed us.

In a joking way one of our boys said he would go over to our right and get a noted quartette from the 42nd Artillery.

"That ought to scare the Huns off until we can eat our chow," he said.

So off he dodged and in a short time, sure enough, he came back with the quartette.

"Now sing—for God's sake, sing!" said the Yank private, and the quartette began to sing the old song, "Don't Drop Your Biscuits on Mother's China Plate."

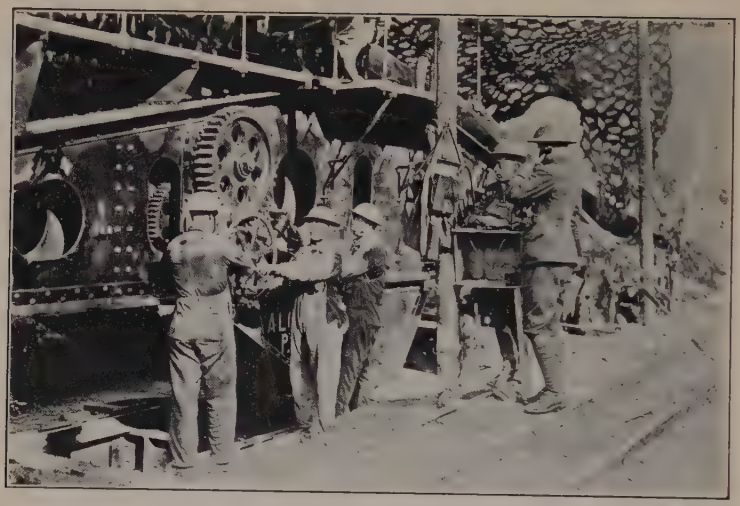
And would you believe it, the firing from the enemy actually ceased and those 42nd Artillery fellows won the title there and then of "The Charmed Quartette."

Verily, music hath the power to charm the savage beast.



GAS MASK TELEPHONE TRANSMITTER

These men are using gas equipment while receiving telephone instructions from an observer attached to Battery A, 108th Field Artillery.



U. S. Official

A LONG DISTANCE TELEPHONE CALL

Induced by one of the monstrous railway guns, located in the forest of Sommedieue, in the latter phases of the Meuse-Argonne drive.



U. S. Official

LONG DISTANCE TALKING—BY GUN AND PHONE

Firing of the 310 mm. gun which is equivalent to the American 13.9 inch.

CHAPTER XLIV

TELLTALE SIGNALS: BUZZ, BOOM AND FLASH

If you were to make a personal canvass of all the officers and soldiers who fought at St. Mihiel, asking each the meaning of two words, "gonio" and "intercept," probably not one in a thousand could answer. And yet both gonio and intercept played so vital a part in determining the course of the St. Mihiel attack, that had it not been for them, the American losses at St. Mihiel might have told a far different story.

Gonio—or, to use the full technical term—goniometry, relates to that branch of the Signal Corps whose job it is to locate enemy radio stations by detecting the direction of their sound. It differs from the intercept work of the Signal Corps in this, that whereas the work of the Gonio Division was to locate enemy radio stations, the work of the Intercept Division was to catch—"intercept"—enemy radio messages, decode them, and profit by the information thus secured. Carefully taking bearings on a particular enemy radio station, each of a series of these gonio stations passed the data along to a charting officer, who noted the points of intersection of these bearings and was thus enabled to locate the particular enemy station with minute exactness. Precious information was thus placed at the disposal of the Intelligence Section, which was enabled to ascertain, not only the enemy messages secured by means of our intercept stations, but also the exact

point from which the messages originated. Often the Signal Corps was further enabled to detect, almost as clearly as if the observation were made directly by means of a telescope, the concentration of enemy troops in different sections of the line as reflected in radio-activity on the part of these enemy stations.

"The location of all enemy radio stations in their proper places, by means of gonio bearings on the night before the attack," says the Report of the Chief Signal Officer,[1] "was the determining factor in the decision of the Chief of Intelligence that the enemy had not already withdrawn from the St. Mihiel salient."

Before our attack on St. Mihiel, there were many indications that the enemy had withdrawn. The final decision to make the attack by strong artillery support was based upon the evidence of our gonio stations that the enemy was still active in his old locations. It was a vital bit of information.

The work of the Gonio and Intercept Divisions in the World War is replete with dramatic incident, for it was not only at St. Mihiel that these specialists of the Signal Corps demonstrated that extraordinary alertness which resulted in the saving of countless thousands of lives. "Upon several occasions," records the Chief Signal Officer,[2] "the efficient work of our intercept operators was cited in secret reports." In the early days of the service, a commendatory report on the operations of the Radio Section of the Signal Corps concluded: "The net result has been that in this period of . . . days the information furnished by the Radio Section has probably saved more men than are engaged in this service."

[1] Report of the Chief Signal Officer to the Secretary of War, 1919, p. 323.

[2] Idem, p. 321.

Time and again the intercept operators of the Signal Corps, whose work, according to one writer,[1] "combined the discoveries of Ohm, Volta and Galvani, with the methods of LeCoq and Sherlock Holmes," succeeded in securing information for our Intelligence Section which proved of the highest military importance.

On April 24, 1918, an intercepted message announcing a projected enemy raid, was decoded in ample time for our troops to be ready to repel the raid when it took place. Four days later, another enemy radio message announcing the raid reached our troops thirty minutes before the attack occurred, and again the raid was easily repelled.

Our Allies, also, were enabled to profit by the alertness of our intercept operators. On June 14, 1918, an enemy message announcing a projected attack on the French was intercepted, and the French were warned in ample time to prepare for the blow.

The finesse attained by these radio experts early in the game is well illustrated by an episode which occurred back in March 1918.

On March 13, 1918, an enemy message in an entirely new code was intercepted by our operators. Immediately the latter pricked up their ears. A complete and radical change of code could mean but one thing: the long delayed enemy offensive was about to take place. Then a message from a German station was caught asking another German station to repeat the new message in the old code, inasmuch as it was not understood. From the called letters given in the message, it was possible for our Intelligence Section, in co-operation with Intelligence Sections of the

[1] E. Alexander Powell, in "The Army Behind the Army," Charles Scribner's Sons, p. 16.

Allied Staff, to work out a complete solution of the new cipher, and before long the Allies were reading the new code messages of the enemy better than the Germans themselves.

As a curious commentary of the much vaunted German efficiency contrasted with American unpreparedness, when a code book was stolen from us by the Germans, not only was another code ready, but our operators were actually prepared to use it when the order went out to put it into immediate effect.

Not only has the work of the gonio and intercept branches of the Signal Corps been more or less of a mystery to the American Army as a whole, but it is a question whether the Radio Division of the Signal Corps as a whole, and the part it played in the World War, have been fully appreciated. Nothing could have been more characteristic of this general attitude than the comment of the doughboy on leave in Paris, who, upon arriving at the Champs de Mars, and noting the glistening antennæ sloping down from the lofty crest of the Eiffel Tower, exclaimed to his companion; "Gee, they must be fixing up a show for us. Look at the wires for the tight rope guys to slide down on!"

While it is true that the American Radio never fully attained its true possibilities, for reasons discussed in a previous chapter, with the result that a great deal of our radio equipment came from the French, it is also true that during the brief time at our disposal for the development of this important branch of signal accessory, a surprising amount of ground was covered by the U. S. Army Signal Corps. This was largely due to the wise policy of the Chief Signal Officer already mentioned, in enlisting to the fullest extent

the aid of our industrial organisation. As the Chief Signal Officer observes: [1]

> In carrying out the programme for development of radio apparatus the Signal Corps called upon a great many industrial engineering organisations and individual engineers for assistance in solving the problems incident to this work. The greater part of the actual development work has been accomplished by organisations and individuals outside of the military service, their work being directed to a large extent by the engineers of the Signal Corps. It is impossible to print a complete list of the companies and individuals that contributed effectively to this work, but the contributions which have been made by certain companies have been so noteworthy as to justify mention in this article. Because of its unusually large engineering organisation and its familiarity with so many of the fundamental problems which were involved in the development of radio apparatus for the Signal Corps, the Western Electric Company has contributed much more largely to this programme than any other organisation.

The A. E. F. Radio Division was organised on October 17, 1917, by Lieutenant-Colonel Lewis R. Krumm, immediately upon the latter's arrival in the A. E. F. Krumm was one of the radio experts selected by Colonel Carty for General Russel, another being Captain E. H. Armstrong. The splendid radio work of our Signal Corps in the A. E. F., which has been the subject of laudatory comment on the part of our Allies, is due in no small part to the high qualifications of these experts, selected after a careful canvass back in the States. Much credit also belongs to the effective co-operation and support on the part of the Radio Division of the Signal Corps in Washington, a large share of whose activity is due to another expert selected by Colonel Carty, a young man named Nugent H. Slaughter, one of the experts attached to the engineering staff of the

[1] Report of the Chief Signal Officer to the Secretary of War, 1919, p. 249.

Western Electric Company, and one of their most promising specialists in radio research. General Squier very quickly recognised Slaughter's qualifications, and the young Major was promoted to Lieutenant-Colonel and put in charge of the radio development section of the Signal Corps.

The contributions of the latter to the radio activities of our army are too numerous to be detailed here, but the most important, perhaps, is that which revolutionised the old standard army "pack set"—a bit of radio telegraph equipment about as easy to move around as an old fashioned square piano without casters. Despite its large and clumsy antennæ, its inefficient source of power—it required three or four husky men to generate by hand the necessary current—to say nothing of its awkwardness and immobility which made it necessary for the equipment to be carried by mules, this old set had secured a prestige and the force of an established institution among Regular Army officers, which made it almost sacrilegious to suggest any modifications or improvements in connection with it. Indeed, it is due in no small part to the fact that the old "pack set" was what it was, that it was so highly unpopular and so rarely used, comparatively speaking, at the front.

Slaughter developed a radio set (which, unfortunately, was not substituted for the old one until after the Armistice), that represented an immense increase in the efficiency of radio telegraphy for military purposes. It was a field set which could be operated by one man using antennæ of almost insignificant proportions, and was capable of being easily carried about by one man much as he would carry about his own personal pack. With this device, two signal men could go out into the field, travelling separately in any direction, and within a radius of three or four miles they could keep in

perfect touch with each other. What is more—and this was another radical improvement—each could interrupt the other in the course of transmission, because it was not a "one-way," but a "two-way" set. The new device presented practically no difficulty whatsoever in the matter of wave interference—one of the things dreaded by radio operators—and marks a distinct achievement in the field of radio telegraphy.

Perhaps no single mathematical principle was so widely used in the World War as that of triangulation, or the location of unknown points by the intersection of lines projected from different angles of observation. We have already seen how this principle has been applied in the location of enemy submarines and of enemy radio stations. There was still another phase of warfare where triangulation played an important part, and that was in the location of enemy guns by means which have become generally known as "sound ranging" and "flash ranging."

Although it was the French who first conceived the idea of applying sound ranging principles in the location of enemy guns, it was the British, or Bull-Tucker apparatus that was finally used as a working model for the American apparatus made up by the Western Electric Company.

When General Pershing, on his visit to the British front, first observed the sound ranging apparatus in operation, he immediately decided that steps must be taken at once to provide similar apparatus for the American Army. "I would like to have a quantity of these sets," he requested of the British authorities, "made up for use by the American Army. If you can't spare them as models, we can make up our own sets back in the States from your designs."

The British furnished the designs. They also furnished,

in the interim, the apparatus actually used at the front by the American Sound Ranging Service.

In the meantime, the designs were forwarded to the U. S. Engineering Corps at Washington, and in due course arrived at 463 West Street, New York City, the headquarters of the Western Electric Company's New York laboratories.

Something had evidently happened to the designs en route. Says P. M. Rainey, of the Western Electric Company:

> We thought we had experience with designs that were Chinese puzzles, but these designs when they got to us were by far the worst puzzle we had ever seen. None of us at first could make head or tail of them. You must remember that there was practically no one on this side who knew very much about the matter because of its exceedingly confidential character. We got a great deal of help, though, from Captain H. B. Williams, of the Engineering Corps, stationed at Princeton, New Jersey, under whose general instructions this work was carried on.

There is a story about Horace Greely, whose wretched handwriting was proverbial, to the effect that a hen wandered into his editorial office one day in his absence, and, upsetting a bottle of ink, left her inky hen tracks over several sheets of blank paper nearby; whereupon the typsetter, mistaking the hen tracks for Greely's handwriting, proceeded to make up from them an excellent editorial. This is about what happened to the designs for the sound ranging apparatus forwarded by the British, for out of them, an excellent working model emerged. Work on the designs was begun on January 22, 1918, in the room designated by the Western Electric engineers as the "dug-out," carefully guarded by day and night against intrusion on the part of any one but the handful of engineers directly engaged on the work.

On April 16, 1918, the first set was completed and taken



Centre: Goniometric Station in France.
Upper left: Lt. Col. Herbert E. Shreeve.
Upper right: Lt. Col. Frank B. Jewett, technical Chief of the Western Electric Company.
Lower left: Lt. Col. Nugent H. Slaughter.
Lower right: E. H. Colpitts, central figure in the "Colpitts Mission."



U. S. Official

RADIO SET

In use at Molliens-aux-Bois, France, June 26, 1918.

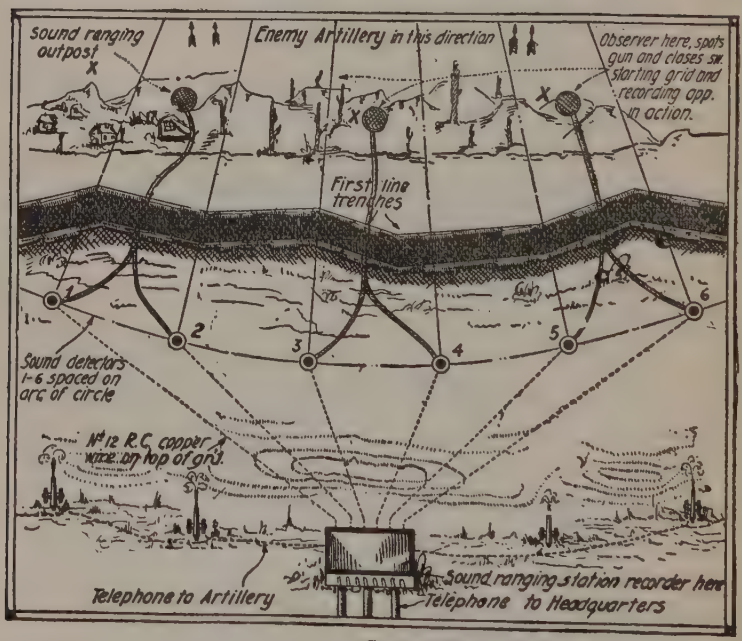
to Princeton, New Jersey, for a field test. The test exceeded all expectations. A few days later the equipment was packed for shipment overseas.

The apparatus was received in France about June, 1918, at the American Sound and Flash Ranging School, headed by Messrs. N. R. French and J. Q. Stewart, of the American Telephone and Telegraph Company. And here we have the same story applying to apparatus designed for front line use and manufactured three thousand miles away from the immediate front: the apparatus had to go through a remodelling stage in the hands of those directly and intimately acquainted with front line conditions. The Sound and Flash Ranging School took the apparatus manufactured by the Western Electric Company back in the States, remodelled it along lines more closely adapted to immediate front line requirements, and submitted it to the Paris branch of the Western Electric Company for manufacture along the remodelled lines; and under the immediate direction of a non-commissioned officer of the Sound and Flash Ranging School, the apparatus was rebuilt and re-equipped so as to be most effective for front line use.

In the meantime, Major (later Lieutenant-Colonel) Augustus Trowbridge, of the Engineering Corps, originally Professor of Physics at Princeton University, to whom had been assigned the immediate direction of the development of sound ranging apparatus, had been making a thorough study of the operation of this apparatus at the front, and, primed with a first-hand grasp of the practical combat requirements in connection with this work, returned to the States and started the Western Electric Company engineers anew upon the apparatus along more effective lines.

In principle, sound ranging is simplicity itself. The

sounds accompanying the firing of a big gun are three in number: first, there is the ear-splitting crack of the shell as it tears its way through the atmosphere; second, there is the low reverberating boom of the discharge from the muzzle; and third, the explosion of the shell as it finds its mark. All three effects may appear on the record, and experienced observers can usually read from the sound waves considerable information as to the type and calibre of the gun.



Courtesy Electrical Experimenter Magazine.

LOCATING ENEMY GUNS BY THEIR SOUND

The above chart shows a typical layout of "sound ranging" stations at the American battle front in France, as actually used for locating German artillery. The photographic record of enemy gun bursts was recorded at the Sound Ranging Headquarters Station, from which wires radiated to the various Listening Stations, placed along the arc of a circle at 1, 2, 3, 4, and so forth. Every enemy gun was accurately located, numbered and charted in this way. This chart was designed by Professor Augustus Trowbridge, of the Department of Physics, Princeton University, formerly Lieutenant-Colonel in the Engineering Corps, in technical charge of the Sound and Flash Ranging Service of the A. E. F.

The sound ranging system consists of several sound receivers placed at charted points along the front, and within a mile of it, connected by circuits converging toward a central station to the several suspensions of a rugged recording device. The record is photographically ruled into small fractions of a second under the control of a special electrical chronometer. The relative times of arrival of the muzzle wave of a distant gun at the different receiving stations can then be scaled off, and, the velocity of sound being known, the gun position with respect to the known points can be graphically computed. Corrections are readily applied for wind and temperature.

"The value of this method," says N. R. French, of the Sound and Flash Ranging School of the A. E. F., "can be judged when it is stated that it was capable of locating a gun at a distance of five miles within an area of approximately fifty yards; and in the large proportion of cases, the area was not greater than 75 yards at the distance stated."

The relative position of adjacent guns or explosions can be gauged within about 10 yards. The record of the muzzle wave can be used to locate an enemy gun, and that of the explosion of the shell sent against it to tell the effectiveness of the shot. In this way fire was directed with telling effect. It has been reported that at one part of the front, the Germans found it necessary to keep their big guns five miles farther back of the front than did the opposing Allied Army.

It is still an unwritten chapter of World War history how at least one of the long range guns which bombarded Paris, was located by an American sound ranging station, and, as a result, put out of commission.

One night, at an American sound ranging station some distance behind the lines, the operator in charge noticed on

the smoked paper recording device, a faint, thin, barely visible line, indicating a disturbance at a considerable distance. The next day he made a report of it.

"At exactly what time did you note the disturbance?" he was asked.

He gave them the exact hour and minute.

"Why, that was the time when Paris was shelled by a long range gun!" was the exclamation.

Two additional sound ranging stations on the French front were now assigned to co-operate with the American station and be on the watch for any similar disturbance. Sure enough, some time thereafter, the same faint disturbance was visible on the recording device at the American station which had originally detected it; but this time the French stations co-operated with the American station, so that by means of triangulating from a distance covering something like 15 miles of front, they were able to locate, exactly, the long range gun shelling Paris.

There is a sequel to the story, and it involves a friendly dispute between the Engineering Corps and the Air Service Corps of the American Army.

Some time after the above mentioned occurrence, a reconnaissance plane of the Air Service was dispatched to the location of the long range gun for the purpose of taking an observation photograph. When the photograph was developed, it indicated the location of the gun at a point some distance off from that shown by the Sound Ranging Section, and the latter came in for a good deal of good-natured chaffing in consequence; for naturally, they had been considerably elated by what was held to be a distinct achievement of the Sound Ranging Service. A trifle discomfited, they nevertheless insisted upon the accuracy of their method; and before

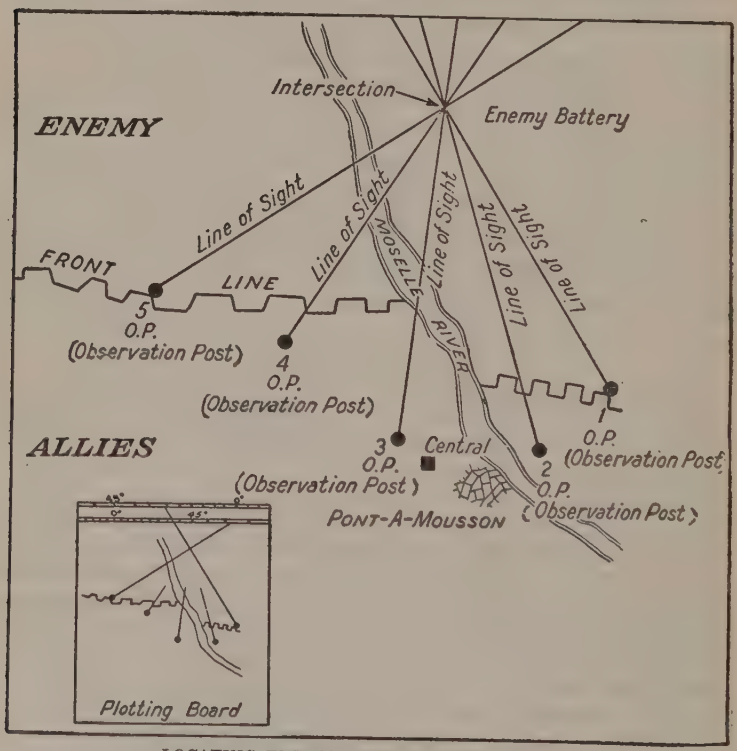
very long they were triumphantly vindicated. It transpired that what the aerial photograph had shown, was not really the long range gun at all, but a very clever dummy erected by the Germans as a pure bit of camouflage. The real long range gun, which had done so much damage, was discovered in the immediate vicinity of the exact spot indicated by the sound ranging apparatus!

Then there is the story of "flash ranging." Engineers of the Western Electric Company were assigned to the development of flash ranging apparatus somewhat later than to that of sound ranging. Flash ranging also played no small part in the location and destruction of enemy guns. Both N. R. French and J. Q. Stewart of the A. E. F. Sound and Flash Ranging School, agree that the description of flash ranging in operation given by Sergeant George B. Richards, of The Bell Telephone Company of Pennsylvania, based upon his personal experiences, is one of the best they have ever seen; and it is on that account given here verbatim:

As the name indicates, flash ranging involved the location of enemy batteries by the observation of the flash of the guns. This, however, but incompletely describes the duties and uses of a flash-ranging section. In addition to the location of the batteries, much general observation work was done. By reason of the network of "O. P.'s" (observation posts), all situated so as to command the best view of some part of the sector occupied by the section, very complete data could be given on all enemy activity. Definite location was established by a system of triangulation, whereby the object to be located was sighted upon simultaneously from two or more "O. P.'s." The observation is made through an instrument similar to a telescope, provided with a graduated drum for measuring angles. This feature may be compared to the familiar survey in transit. All the posts measure the angle between the object and a given meridian line. This angle is reported to a central station by each post in turn.

Right here the telephone plays an indispensable part. All posts

are connected with a central switchboard by a metallic line. In Central is located a plotting board, upon which is pasted a map of the whole area under observation. The computer at Central, upon receiving the reports from the "O. P.'s," draws lines on the plotting board representing the angles reported. At the intersection of these lines the object is located. During a heavy enemy bombardment, it is obvious that flashes would be seen at many points on the sector. If each observer should turn in a bearing on a different gun, an intersection, if one should be obtained, on the plotting board would be far from accurate. To



LOCATING ENEMY GUNS BY THEIR FLASH

Chart showing flash ranging system in use at the front and method of locating by triangulation exact positions of enemy guns. This chart was designed by Sergeant George B. Richards of The Bell Telephone Company of Pennsylvania, based upon his personal experiences in charge of a flash ranging section at the front.

overcome this, a method of synchronisation is employed. On the central board a series of lamps are mounted, much like the subscribers' lights in our telephone offices. These are numbered and connected, one to each post. Depressing a key in the "O. P." lighted the lamp associated with that post. A buzzer was arranged to be switched in circuit with any of the lamps.

Let us now form a mental picture of a flash-ranging section at work. Up on X-on hill, directly facing the enemy, is a little concrete "pill box." The only opening toward the enemy is a long, narrow slit, just allowing the objective of the observing instrument to protrude. Within is a little shelf on which is mounted the instrument and the all-important telephone set. Double head receivers and breast transmitters were used with the battery, induction coil, condenser and flash key in the carrying case. A twisted pair of copper-clad iron wires leads out of the post, through trenches wherever possible, to the central office. Other posts are similar in appointment.

Central is a little dugout up in the woods, a little too far back to be bothered by direct fire, yet so close that the "big boys" go sailing by overhead, only to burst far behind. A little six-line board is mounted on a box, with the operator seated before it. The log book is open at his side. On a couple of trestles we find the plotting board, presided over by the Sergeant-in-charge of Central. A little acetylene lamp furnishes the illumination. The keys are thrown on the board, so that all posts are connected together.

The enemy opens up with some "heavies." Into the alert ears of the central operator comes a call.

"One Post gets flash northwest of Pagny."

"All posts get on it; One Post will lead!"

The buzzer is switched to Number One line. At each flash, Number One Post presses his flash key. The little lamp lights up on the board, and the buzz is heard simultaneously throughout all posts. The observers eagerly search the area indicated by Number One Post for a flash occurring at the same instant as the buzz. All other flashes are ignored at this time.

"Three Post gets it!"

The voice comes from Number Three Post via the trusty telephone. Now two lights are flashing together on the board.

"Two Post, where are you?"

"Two Post has it!"

Three lights flash.

"Five Post speaking. Dead ground to us!" The flash is too far to the west for Number Five Post to see.

"Four Post, are you dead? Four Post! D——! Can't raise Four."

The wire chief jumps to his little home-made test board, pegged on to the dugout wall. A little French milammetre that he has "salvaged," says Number Four Post's line is open both sides, this side of the lineman's billet.

"Shot out again at Montanville! Third time this evening."

Poor old Bill, the lucky Sarge of lines, has just tumbled into his blankets like a horse, i. e., with his shoes on, after having closed in a nasty break in the trees of an old orchard near Montanville. Bill is up instantly without a grumble, of course. (He is a Bell man from Cincinnati.) He routs out another man, rules requiring two men to travel together at night, slings his test set on one shoulder, gas mask on the other, and with a pair of eight-inch side cutters (as a weapon of defence against a stray Boche), starts out.

Meanwhile, in Central, three of the lights have flashed together several times. Synchronisation is assured, and we are ready to locate.

"All posts, your bearing?"

"One Post, 0.924."

"Two Post, 1276."

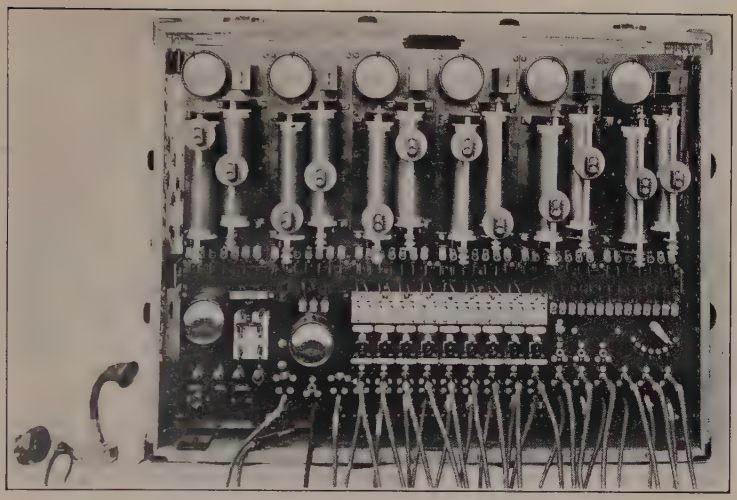
"Three Post, 1487."

"Check. Pick up new flash!"

The plotter hasn't been idle. He has a head 'phone tapped in on the switchboard, and as the bearings are called in, immediately lays out a line on the plotting board from the "O. P." to the bearing on the scale at the edge of the board. Three such lines have been laid, and they cross at a point behind the woods near Pagny.

A new battery! In an ideal place, near a hard road, the Boche have set up a new heavy battery and are banging away without anyone being the wiser, until our F. R. S. has picked them up.

The plotter has the co-ordinates figured and the wire chief, if we may dignify him by that title "up there," has gone to the little ten-line French drop board which hangs on the wall. A Western Electric Company's field telephone set is equipped with a French cord and plug for the talking and ringing apparatus. He plugs into A. I. S. (Artillery Intelligence Section), getting the C. O. there at once. Quickly he gives the co-ordinates, and



TO LOCATE GUNS BY SOUND

Apparatus designed by the Western Electric Company and later modified at the front by N. R. French and J. Q. Stewart of the American Telephone and Telegraph Company.



SET FOR LOCATING AIRPLANES

Long horn anti-aircraft set used in accurately locating enemy airplanes, either at night or during the day.



U. S. Official

CAMOUFLAGED HEADQUARTERS

An entrance to the dugout of the 26th Division in France. Could the enemy see this profusion of telephone wire they would know at once that it was a headquarters—hence the camouflage.

the added information that it is a "P.," i. e., accurate within 50 metres' location and a new battery. Sizing up the location, the Commander hastily decides that the battery behind Montanville is the one to return Fritz's compliments.

We "ring off" on A. I. S. and plug in on P. C. Hall. We just finish turning the magneto when——

"P. C. Hall," says the post commander. Within a very few minutes after he receives the location, we hear (and feel) the big nine-inch English guns sending word to the enemy that his attentions are undesirable. Shortly after, the new enemy battery ceases to operate. We wonder why, although we think we know.

A visit to the location after the Armistice, months later, reveals the answer for certain.

A direct hit.

* * * * * * *

Now surely it would be rather rough on Bill and his buddy to leave them groping among the gravestones in the thoroughly shelled cemetery behind Montanville. Occasional 77's and 110's burst near enough to keep away that lonely feeling. A grating noise in the receivers at Central, and Bill has "cut in."

"Hullo! How is it here?"

"O. K."

"Rich" jumps to the test board, and gets a shunt, showing all good.

"Good to there, keep on going."

Right near the east wall, where the wire crosses over it, Bill, trailing the twisted pair through his hand, suddenly comes to the end. Where's the rest of it? It's pitch dark, and Bill isn't going to get shot for making a light. He goes ahead to the hard road where the wire runs on stakes. Holding on to it he traces back, and again comes to the end. About 150 feet are shot away. They aren't stuck, though. The wire is run on the ground with plenty of slack, so it is quite possible to straighten out the curves, pulling up from each end and making a hasty splice. Before he can tap in and report, Number Four Post is aware of his reconnection and, evidently much relieved at his release from temporary isolation, reports "All's well." Bill and his buddy trudge "home," hoping the cussed Boche won't get them out again before morning.

* * * * * * *

Summing up the telephone work, let me quote the Commanding Officer of the section. He commended the faithful and untir-

ing work of the telephone men in keeping continuous the service "which played no small part in our success."

The section, while only in operation a short time, accurately located twenty-two new batteries, and gave ten indications which were found later to be fairly good; this, in addition to reporting the activity of known batteries and much general information.

Harry Williams, of the Bell of Cincinnati, Ohio, was chief linesman, with grade of Sergeant. George Richards, of Philadelphia Bell, was chief "everything else electrical," with similar grade.

Finally, there was the problem that confronted American engineers during the war of locating enemy aircraft in flight, where such aircraft was invisible either because of distance by day or darkness by night. This, too, is a problem to which the Western Electric Company directed a good deal of its attention.

The author makes no pretence to understanding the perplexing detail, including the mysteries of engineering and of higher mathematics, involved in the solution of this weirdest of problems. He gave up in despair upon contemplating that uncanny creation which was finally evolved by the Western Electric engineers, whereby a bewildering collection of cogs, wheels and the like, acting upon nothing stronger than sound absolutely inaudible to the human ear and proceeding from a bombing plane miles away in the dark, automatically traced the course of the invisible enemy plane by means of an electric light, which duplicated in a glowing trail the itinerary of the invisible plane, so that you could see whether it was travelling in a dangerously straight direction towards you, or in a zig-zag direction which indicated only too clearly that the pilot had lost his bearings. The explanation furnished to the author by one of the Western Electric engineers, is herewith passed along to the reader without change:

Air warfare makes vulnerable strategic points behind the lines,

Towns and cities are bombed, and ammunition dumps, supply depots and railroads are objects of special attack.

It became necessary early in the war to develop anti-craft artillery and tactics for its use. The defence problem is especially difficult since airmen approach objects of attack with great speed, and moreover, a great deal of bombing work is done at night. What was needed was apparatus for locating airplanes several minutes at least before they reached their objectives, and perfectly adequate when vision is obscured, as by night or in fog.

The first attempts at the solution of this problem were purely acoustical devices, making use of the binaural[1] sense. Professor G. W. Stewart, of the University of Iowa, also co-operated with the Engineer Corps in these experiments. According to this first method two pairs of sound-collecting horns are mounted to swing one pair horizontally and the other vertically. The two horns of a pair are connected one to each ear. The observer can with practice turn the horns and point them quite accurately at the enemy flier. In doing this he simply follows the dictates of the same sense of direction that we use in locating any of the common sounds which attract attention in the course of our daily experiences. It is simply the two-ear or binaural sense of direction possessed by all persons with normal hearing.

More sensitive detecting means were required, however, and a more highly developed system for its use, in order that locations might be spotted quickly enough to get anti-aircraft batteries and searchlights into action before the enemy had carried out his design.

A microphone was developed in our New York laboratories which, when attached to a horn, had such remarkable properties, that it enabled the observer to hear a plane about four times as far away as with the unaided ear.

The detecting system of aircraft defence as finally developed, consists of three observing stations at the corners of a triangle a mile or two on a side, with circuits from each running to a central plotting room. Two of the base and detector stations are used at any one time to determine the location and altitude, and to track the course by automatic triangulation on a plotting board.

As a base end detector station four horns, two forming a horizontal pair and two a vertical pair, are arranged to be inde-

[1] See Chapter XXXVII, p. 428, for explanation of the binaural principle.

pendently rotatable, each pair in its own characteristic manner. Two observers, the first horizontally, the second vertically, control these rotations, each being guided by the binaural effect, heard through a pair of ear receivers connected to his pair of horn detectors.

The horizontal and vertical motions of the horns are electrically communicated to plotting boards at the central station where pointers show the location of the airplane both in horizontal plane and in altitude. Thus the system permits of patrolling the air for aircraft within range, and of tracking them in their flight.

Sound travels at the rate of about 750 miles per hour, and wind and airplane velocities, while much less, are not usually negligible in comparison, so corrections are necessary. Moreover, in making predictions by which to control anti-aircraft batteries, the time of travel of the airplane sounds and the time of projectile flight are some of the further factors that must be taken into account.

With such a system in operation, the enemy bomber can be picked up ten or more miles away, six minutes, let us say, before he arrives over the protected area. In a minute or two his track can be established and "extrapolated" forward for another minute. Batteries and lights are notified to be ready. The aircraft batteries are aimed to deliver a burst of shells at the point where he will be at the appointed moment, and on time the air in the flyer's vicinity for a volume of about an eighth of a mile across is filled with flying steel. Exquisitely timed, the searchlights burst upon him just as the shells arrive, and then the lights and guns co-operate to defeat the purpose of the destroyer and to bring him down.

Naturally, work of this sort fell to men already highly trained by civilian experience in the mechanics of sound and electricity. The establishment of the anti-aircraft radio system in France was chiefly accomplished by members of the Radio Company organised from the engineering laboratories of the Western Electric Company, and designated as Company A, 319 Field Signal Battalion.

The first anti-aircraft radio station established in France, was the one installed on September 4th in the French fort

on Mont St. Mihiel, in preparation for the St. Mihiel offensive. Sergeant George F. Grice, of the Western Electric Company, was in charge of this station. This was followed by the installation of stations at Les Monthairons and Dieulouard on September 8th, and Tremblecourt and Commercy on September 11th. The Western Electric Company men on these stations were Sergeants 1st Class George W. Van Tubergen, Stanley G. Timmerman, Corporal Charles W. Miller, and Private 1st Class Laurence F. Southwick. Additional anti-aircraft radio stations at Sommedieu and Regret, were in charge of Corporal Louis B. Palmiter and Sergeant Emanuel Singer, respectively. An imposing and well equipped station at Ligny-en-Barrois, was in charge of Sergeant 1st Class Leland E. Dorrothy, assisted by Sergeant John C. Cruger, and Corporal Gerald M. Best,—all these men being from the Western Electric Company of New York City.

Paris, as everyone knows, was the scene of many exciting air raids during the war. It was the special prey of the enemy airmen. The 56th Engineers maintained an anti-aircraft searchlight section at Paris, of whose work Robert R. Shue, of the Chesapeake and Potomac Telephone Company, gives us an interesting picture:

Our plat was in Paris, ostensibly for a few weeks' training before going to the front; but we trained on sure-enough bombing planes kindly provided by the enemy in the course of a number of air raids on the city.

In order to operate the light the telephone had to be used. We used a 36-inch French carbon light, mounted on wheels. The light stood about seven feet. A trench four feet deep and seven feet in diameter was encircled by a track sixteen feet in diameter, around which ran still another trench two feet wide and four feet deep. A hole, ten feet deep and five feet in diameter, was dug in the centre for the paraboloid, which could be operated either vertical or azimuth by an iron bar extended to the track,

at a sufficient distance so that the light would not blind the operator and prevent him from holding the enemy plane in the beam.

Between the paraboloid and the light was a dugout eight feet deep and six feet square. In this was the plotting board and a telephone. Four lines ran from this telephone to four "spotters," designated as North, East, South, West, and stationed in holes 800 to 1000 feet each from the light; and each spotter was equipped with night glasses used to sight the planes. The position was laid out in this way because enemy planes always separated and spread out over the city which was their bombing objective; and we were dug in so that the men and equipment were out of danger except from a direct hit.

There were two raids on in Paris while we were "training" there; and when the planes came over you can bet the fun started.

Those who have witnessed an air raid in Paris need no description of its familiar accompaniments. The eerie sound of the siren, like the shrieking and wailing of winds about a deserted tower; or the clang of fire engines drawn by clattering and semi-frantic steeds; the long, white arms of the searchlight reaching out through the darkness toward the starry vault, and finally converging to a point where the enemy marauder, still unseen to the naked eye, is clearly heard and recognised by the familiar double-motored hum of the Gotha; then the terrific crash of the "eggs" as they hit the earth with a simultaneous, lightning-like flash,—a sound resembling nothing so much as the solid impact on the ear which comes from cracking two stones together under water,—only a thousand times magnified; finally the boom! boom! of the anti-aircraft guns, a *sucking* sound, which rattles the window-panes and suggests colossal corks drawn from titantic bottles,—all this will be clearly recalled by those who have experienced any one of the numerous air raids in Paris.

But few there be who have any idea of the defensive

mechanism set up in Paris that ultimately discouraged all future ventures of this sort,[1] and it will therefore be of interest to resume Shue's narrative:

The first of those raids we "trained" on was a corker. I shall describe what we did to locate the Boche plane.

The planes have approached. We hear their hum distinctly. The spotter looks through his glasses. The first plane he sights he reports over the 'phone. That makes him "No. 1 man." The next spotter to sight the plane will become "No. 2 man," and so on.

In this case, North spotter happens to become "No. 1 man." He sees the plane first. He judges his vertical and azimuth as nearly as possible.

"Plane, North, 50-40!" North calls off over his telephone to the central station. The first figure given is azimuth, the second vertical.

I am the only telephone man in our plat, so besides having installed the system I act as Central, receive the reports from the spotters, and relay them to the paraboloid men. They, in turn, make two readings, the first to see in which direction the Boche plane is travelling and how fast, the second as a check and to furnish the time differential. Both readings are reported to the plotter, who plots the exact point the plane should be five seconds after his report to the light operator—allowing the latter this interval to expose his light. The operator exposes his light at the given figures, and nine times out of ten the enemy plane is trapped in the beam!

But speed—almost instantaneous co-operation—is essential. Within twenty seconds after the spotter's report, the light has been exposed and the Boche caught in our beam. Without that telephone we couldn't have done it.

[1] The author was privileged to witness the last night air raid on Paris ever attempted by the enemy. It consisted of two attacks, one at 2 o'clock on the morning of September 16, 1918, and the other several hours later. Paris newspapers that morning described the raid as the most violent of the war, as it was also the most costly to the invaders.

CHAPTER XLV

THE MEUSE-ARGONNE

In order to convey an adequate picture of the part played by the telephone, telegraph and radio in the greatest of all battles in American history, it will be necessary, first, to give some rough idea of the task the Allies had set for themselves, the obstacles in the way, and how far these obstacles were overcome.

The battle of the Meuse-Argonne, so called because its main attack was delivered by the American Army on a 25-mile front between the Meuse River and the Argonne Woods, was in reality a combined, simultaneous Allied offensive all along the Hindenburg Line: the united attack under a unified command that Ludendorff had feared more than anything else.

It was, in a way, a repetition of the St. Mihiel affair on a far larger scale: a pinching-out of the enemy from the huge salient formed by the Western Front.

Between the American and French Armies, the Argonne Woods ran northward for about 6 miles. The idea was, not to make a direct frontal attack upon this forest, but to force the enemy out of it by the threat of surrounding it. The Americans were to flank it on the east, the French on the west, and both were to join in back of the forest from which, by this time, the enemy would have withdrawn to avoid being surrounded. Then the French and American Armies, joined

behind the Argonne, would repeat the process on the wooded hills north of the Argonne. The two armies would then press northward toward Sedan, while the British, starting from the direction of Cambrai, would press eastward toward the same goal, so that the combined Allied forces would crowd the German Army into a state of helpless congestion from which, backed up against the Ardennes Forest, and with the Sedan-Mezières railroad cut, Ludendorff could not possibly hope to extricate himself, and would have to surrender or suffer the worst debâcle in history.

Thus stated, the plan sounds simple enough. As a matter of fact, it involved an almost superhuman task. Anyone who has seen, in all its roughness and ruggedness, in all its horrible desolation, that region in eastern France which was designated as the Hindenburg Line, will wonder no less at the temerity of the Allied commanders in attempting to force the enemy out of this district, than at the almost unbelievable and yet undeniable fact that the task was, in large part, ultimately accomplished.

"At the conference of Allied leaders when the great general attack was planned," says Clair Kenamore, one of the leading war correspondents,[1] "the French commander in chief asked:

" 'Where will the American Army fight in this battle?' "

" 'Wherever you wish it to fight,' " General Pershing replied.

General Foch then indicated the line between the Meuse and the Argonne, and asked if they would take that part of the line. General Pershing assented. It was the part of the line where the heaviest fighting undoubtedly would be if the battle plans

[1] "From Vauquois Hill to Exermont," by Clair Kenamore, p. 76, Guard Publishing Company, St. Louis, Mo.

worked out, and if the judgment of the military men proved true. Every officer present knew that. The Allies were at a point in the operation where a continuation of their strokes would drive the enemy out of France, or he would suffer disaster, possible annihilation of his armies in the field. To get his armies out he must maintain his communications, the four-track railroad at Mezières in front of us, and the business of the Americans was to threaten, and, if possible, to cut his communications.

It was a field where there was a certainty of the hardest fighting. It was probable that the Germans would bring their best battalions there to make the vital fight. As a consequence there could be no spectacular gains on the American front. Every foot of ground would be contested bitterly, and those who advanced must pay the price. While on the other fronts, large and glittering gains would be made in a day, it would be against a retreating foe, and he would be retreating all the more hurriedly because of the pressure the Americans were bringing on his vitals. The enemy could not retreat on our front. If he did, we would cut his railroads and the French and British to the west of us would capture his armies. It was with a full understanding of what was ahead that the American commander took his post of high honour, where hard blows were to be given and taken, and where there was little to gain.

Kenamore has not overdrawn the picture. It was probably as difficult a battlefield as ever furnished setting for bloody encounter between man and man: "a sort of labyrinth of chaos, trenches, caves, rabbit warrens, buttressed with railroad iron, sown with cement structures—monstrous turtles with a single aperture, left for machine-gun barrels. Difficult, well nigh impossible to pass when the battle had gone beyond, was this wilderness, filled then with the debris of conflict, with half-buried bodies, rotting equipment, broken guns; crammed with hand-grenades, with every conceivable engine fatal to touch; having an order, a plan, a method, but revealing it nowhere; concealing an underground world, stretching endlessly like the Catacombs, old quarries newly organised, vast warrens capable of sheltering platoons, whole

companies, and reached by stairways going down to the very nethermost depths." [1]

Such, very briefly, was the task the Allies had set for themselves, and such were a few of the physical obstacles to be overcome. The character of the opposing forces is known to all: on the American front alone, where the main attack fell, Ludendorff began with four and ended by concentrating forty of his best divisions—five-year veterans under officers trained by a system of military technique developed in the course of more than two score years of rigid discipline.

Now as to the preparations for carrying the general Allied plan into execution.

The most important element, of course, was that of surprise. The Germans knew, in a general way, that the great offensive was on its way; they knew it was to begin somewhere in the neighbourhood of Verdun; but *just where* it would strike, was precisely what they did not know. It might start east of the Meuse River and proceed in the direction of the Briey iron district; it might (as it did), strike northward between the Meuse River and the Argonne Woods; or it might strike anywhere to the east or the west of that.

The Americans knew the Germans' quandary, and by "a sheer, low-down Yankee trick," aggravated it still further. There is at least one group of Americans whom Ludendorff will probably never forgive, and that is the group of telephone and radio operators who, prior to the Meuse-Argonne outbreak and clear up to the Armistice, practised a form of deception of which the enemy never suspected our Army to be capable.

[1] "History of the World War," by Frank H. Simonds, Vol. V, p. 249, Doubleday, Page & Company.

As told by General Russel, Chief Signal Officer of the A. E. F.:

Prisoners declared the enemy was in fear of an attack in the direction of Briey and Metz.

It was accordingly planned to increase the enemy's fears by establishing a false army radio net on the Beaumont-Fresnes front, and sending messages indicating a general offensive on that front, in a cipher which the enemy would be sure to decipher through apparent carelessness in its use. Furthermore, telephone lines along this front were established in a manner to enable the enemy stations to intercept conversation indicating the coming offensive. The outcome of the whole matter was, that two enemy divisions were held in reserve at Metz, even after the attack was delivered west of the Meuse, because of fear of an attack east of the Meuse.

And the New York *Tribune* goes on to furnish details of the operations of this mythical American Army, known as the "X Army":

The sector in which the "X Army" was at work was directly under the command of the 33rd French Corps, and the roving wireless station caused considerable excitement among the French soldiers, as it sent messages to make the enemy believe that several fresh American divisions had moved into the area. The French, unaware of the plans of the "X Army" Staff, at times thought the Americans had lost all sense of reason and on several occasions so reported the wireless plants.

In addition to the wireless, the "X Army" also had in operation, on the front between Bezonvaux and Fresnes, a telephone squad—a careless squad—which set up telephone stations here and there and sent messages and talked shop and gossiped at night about the arrival of some old friend from America with such and such an outfit.

The "X Army" telephone squad took no chances that the Germans might not hear the conversations the Americans desired them to record. They deliberately grounded their wires so the enemy could "listen in," and crawled out into No Man's Land in the darkness and hooked one of the American wires over on to a German barbed wire in front of an abandoned trench system.

Two days after the "X Army" began functioning the results

began to be noticeable, the nervousness on the part of the Germans being exhibited in many ways, the enemy first sending over a large number of airplanes to make reconnaissances. The Germans also began a series of trench raids to obtain prisoners for the purpose of identifying units of the forces opposite them. German prisoners captured by the French told of wild alarms in the night on the part of the German forces, hurried reinforcements of the main line of resistance and various other movements which indicated that the enemy was exerting extreme watchfulness on account of the activity of the little army being operated by a handful of Americans.

When the Armistice became effective, November 11th, the little American mythical "X Army" still held its ground in the field near Verdun, and opposite, five crack German Divisions stood their guard, not even suspecting that they had been tricked by a handful of ingenious young Yankees, who were delighted at the results obtained by their mischievous schemes which had worked so successfully in deceiving the wise old German veterans of a five-year war.

Ingenious and effective as this stratagem proved, it was, however, incidental to the main scheme of the attack. As already stated, the First American Army, under Pershing, was to attack on the right flank of the Argonne; the French Fourth Army, under Gouraud, on the left flank; the British Army, under Haig, on the Hindenburg Line opposite Cambrai. From the extreme right to the extreme left—from the Meuse to the neighbourhood of Cambrai—the disposition of American units in this huge, semi-circle of synchronised attack, was as follows: the III, V and I Corps made up the First American Army; the 36th and 2nd American Divisions were assigned to Gouraud, with the French Fourth Army; and the II American Army Corps, including the 27th and 30th Divisions, were fighting with the British under Haig.

Serving as corps and army troops for the First American Army, to construct, maintain, and operate its main and

lateral axes of telephone and telegraph communication, were the 401st (New England Bell) Telegraph Battalion, the 411th (Pacific Bell) Telegraph Battalion, and the 406th (Pennsylvania Bell) Telegraph Battalion; the first two handling (nominally, at least) the Army net, and the latter, or 406th, taking care of the net for the I Corps.

"Nominally, at least," is said advisedly; for that was the original idea, in accordance with pre-accepted army practice. The army telegraph battalions were supposed to pick up the lines of communication in the rear zones and carry them forward to the army headquarters, thence forward to the corps headquarters, connecting up, at the same time, the various corps headquarters within the army zone. Two telegraph battalions were supposed to be assigned to each army zone for this purpose. Then, to each corps within the army zone, an additional telegraph battalion was supposed to be assigned, to pick up the lines of communication at corps headquarters, and carry them forward to the various divisional headquarters in the corps area, connecting them up, also, to one another. But throughout the entire Meuse-Argonne engagement, the telegraph battalions assigned to the army and corps duties, simply had to forget what the books said, and set themselves to the heroic task of doing whatever the immediate occasion required,—now stringing open lines under shell fire, now reinforcing and amplifying lines of communication to the rear, here and there co-operating, wherever necessary, with the valiant divisional field battalions, often "sneaking forward," in surveying details, almost to the limit of our infantry's advance, in order to lay out the lines that would shortly follow as soon as No Man's Land ahead of them would be converted into a new American corps or division headquarters,—in short, furnishing wire com-

munication wherever it was needed by the advancing American lines.

In addition to the 401st and 411th serving as army telegraph battalions for the First American Army, and the 406th as corps telegraph battalion for the I Army Corps, the 412th, or Southwestern Bell Telegraph Battalion, was serving as corps battalion for the II American Army Corps with the British.

Now as for the general plan of attack, and the preparations that had to be made to provide the all-important wire communication upon which co-ordination of the attack so vitally depended:

Synchronising his attack with that of Gouraud's Fourth French Army on the western side of the Argonne, Pershing was to attack with the First American Army along the eastern side of the Argonne.

Pershing's main attack would be made by his centre corps, the Vth, which occupied a position just opposite Montfaucon, with Hill 304 on its right, and Hesse Forest on its left. Protecting the centre or V Corps on its right flank, was the III Corps, whose extreme right, in turn, rested on the Meuse; while the left wing of Pershing's army was made up of the I Corps, whose extreme left, the 77th Division, was to advance through the Argonne and keep the enemy busy therein,—an infernal task in the truest sense of the word.

Since the main attack was to be in the centre, opposite Montfaucon, the main axis of communication would have to run northward from Rarecourt, and from the Bois Foucheres through Recicourt in a northwesterly direction to the edge of Hesse Forest.

On September 24th, the 411th (Pacific Bell) Telegraph Battalion began the construction of a ten-wire line from

Bois Foucheres to the edge of the Hesse Forest, via Recicourt, and by working every available minute of daylight, and hauling and distributing material at night, completed the line to the edge of the forest just behind the front lines during the night of September 25th. In addition, throughout the period preceding the grand attack, the 401st (New England Bell) Battalion, with its details scattered all along the active front, kept pace with their brethren from the Pacific Coast in the construction and maintenance of the other main axes and laterals of telephone and telegraph communication for the army network. "In between times, just to keep out of mischief," as a member of this battalion facetiously puts it, "we ran a number of important lines for artillery and other branches of the service in the vicinity of the First Army's left wing."

In the general preparations the 406th, or Pennsylvania Bell Battalion, had been far from idle. Immediately upon the heels of the St. Mihiel engagement, the I Corps, or First Army left, by forced marches along miserably inadequate and inconceivably congested roads, had arrived on September 20th at Rarecourt, where they found the French planning to pull out of the sector, leaving the 406th to take over the operation of the entire area of telephone exchanges and lines on the following day.

Accordingly, on September 21st, the 406th assigned its exchange crews to their new duties, dispatched them to the various exchanges to make records of the lines entering the switchboards, etc., and at the same time survey details were started over the region to bring back all the data about the location of lines for Gauss, who maintained a large circuit map of the region up to date, exactly as if he were supervising lines back in western Pennsylvania.



U. S. Official

PROSPECTIVE TELEPHONE BUSINESS ON RUSH ORDER

Examine this picture closely. It was taken immediately behind an attacking wave of infantry. Within a very few minutes after the territory is captured telephone lines will be strung to the foremost position and the territory consolidated with the rear.



U. S. Official

SPEEDING THE PARTING GUEST BY TELEPHONE

With a final ration of "hot buns." Battery C, 108th Field Artillery (formerly 2nd Regiment Field Artillery and 1st Cavalry Pennsylvania National Guard) firing a salvo from the ruins of Varennes after the retreating Huns, Varennes-en-Argonne, Meuse, France, September 28, 1918. The movement forward during this period was very rapid. Enemy telephone and telegraph poles and wires were pressed into service as the American Signal troops moved forward.

Except for the corps telephone exchange at Rarecourt, the principal exchanges in the corps net were at Les Vignettes, headquarters of the 77th Division, the left wing of the I Corps; Clermont, headquarters of the 28th Division, the I Corps centre; and Auzeville, headquarters of the 35th Division, I Corps right. The line connecting these exchanges formed the forward lateral axis of the I Corps.

Next in order of importance was the old French army headquarters at Triacourt. Here a small group from the 406th held sway, to help operate the French switchboard. Scattered between Triacourt and the forward lateral axis, were exchanges at Futeau, Beaulieu, Froidos, Lavoye, Grange le Comte, Autrecourt, Brizeaux and Foucaucourt,—all operated by the 406th.

The Clermont exchange was located in a huge dugout on the side of a hill from which could be seen the whole valley of the Aire as it stretched northward toward Varennes. From an observation post at the top of the hill, entered through a long dark tunnel at the side of the exchange, could be seen all the German positions in the neighbourhood of Vauquois and the eastern edge of the Argonne. Outside of the exchange was a high tower which formed a terminal for the lines connecting to the exchange through cables, and also the test point for some fifty circuits which passed this point but did not enter the exchange. To collect the data concerning these lines was no small job, as the French details had been removed from this and all other exchanges in the corps area, except Rarecourt, just as soon as the corps troops arrived, leaving all the sketches and records in French or Italian, with never a trace of English. The linguists of the battalion were immediately mobilised, and soon Gauss had

an up-to-the-minute circuit map, complete and ready for business.

As the time for the opening of the attack approached, Colonel Voris, Signal Officer of the I Corps, determined to start the open wire line leading north from Clermont, headquarters of the 28th, or I Corps centre division, so as to have a main line of communications ready when the divisions should begin to advance. Price, of the 406th, set out with what men could be mustered, and started the line some two hundred metres west of the main highway, in order that the telephone line might remain unharmed should the highway be shelled. And there seemed every chance that this highway might receive a great deal of attention from the enemy, as the shells were constantly falling around Clermont and cutting the circuits leading from this exchange. For the "high line," poles were cut along the edge of the forest and carried across the fields, the men being kept scattered as much as the work would permit, so as to avoid furnishing easy targets for the enemy on the opposing heights.

All the men that could possibly be collected were used on the new line. A plea was sent to the Army headquarters, requesting that they take over the numerous exchanges in the rear areas, so as to release these operators from the Pennsylvania Battalion for work on the forward line. But these little exchanges were off the American Army axis of advance, and the Army Signal Officer responded, instead, by lending to the 406th Battalion one company from the 401st (New England Bell) Battalion, to help with the construction of the forward line while the operators of the 406th continued to man the small exchanges to the rear, and to maintain the large network of circuits. All the men of the 322nd Battalion who were not otherwise engaged were loaned

to Price, and the line grew rapidly past Neuvilly and toward the front line which was shortly to serve for the "jump off."

On the afternoon of the 25th, a field order was issued which described the attack to be made the following day. Immediately a few of the small offices toward the rear were abandoned and circuits cut through, so that all the maintenance men possible might be placed in the forward areas. The exchanges along the advance lateral had become increasingly active as the divisions moved from these bases toward their final positions in the lines, taking with them their signal men, and leaving the 406th Battalion to carry on not only the corps business, but that which developed from the administrative work of the divisions as well. At Les Vignettes, where Murdaugh, of the 406th, officiated at the exchange, plans were made to move the switchboard—in case the Germans should begin to shell that centre—from the little frame building half buried in the side of the hill, to the large and secure dugout close by, in which all the circuits terminated on a frame with cables leading on to the switchboard.

As a final indication that something extraodinary was about to happen, mounted couriers arrived at Les Vignettes, and instructed Murdaugh to establish an advance message centre for the corps, using the mounted men to carry messages should the circuits between Les Vignettes and corps headquarters be shelled out of existence.

"This," says Murdaugh, "as good as told us that the band was going to play that night."

CHAPTER XLVI

WHEN THE BAND BEGAN TO PLAY

Murdaugh was right. The band began to play at 2:30 sharp on the morning of September 26th: an Overture of Inferno belched forth from countless pieces of artillery in a din that simply beggars all description.

The honour of opening the grand Allied assault fell to Pershing, accompanied by Gouraud and the French Fourth Army on the left of the Argonne. A day later, Haig, up in the Cambrai sector, "joined the band."

Let us follow the progress of the attack, from right to left, facing the foe.

Pershing's immediate objective was that allegedly impregnable portion of the Hindenburg Line known as the Kriemhilde Stellung, at whose base the First Army was expected to arrive by the evening of the first day. The First Army's centre, as we have seen, consisted of the V Corps; its right wing the III Corps; its left, the I Corps. The centre was to make the main attack, take Montfaucon the first day, and arrive at Cunel and Romagne by evening. The centre's right and left flanks were to be covered by the III and I Corps respectively; the former to advance up along the Meuse, the latter to proceed up the Aire Valley and through the Argonne so that its right, the 35th Division, would reach Exermont, its centre, the 28th Division, Apremont, while its left, the 77th Division, advanced right up through the heart of the Argonne Woods.

It was virtually a superhuman task that Pershing had set for his First Army in mapping out the first day's objective. Scarcely less superhuman was the effort put forth to meet that task.

On the right, the III Corps almost completely fulfilled its mission; the 33rd Division advancing through the Forges Woods to the hills north of Dannevoux, the 80th to a little southwest of Brieulles, the 4th to the eastern edge of Nantillois.

It is easy in a narrative to roll off the kilometres of advance; but what it means in blood, brawn and sheer courage, is often forgotten in the mathematical record. As an illustration, in connection with the advance of the 33rd Division through the Forges Woods, we might cite the case of Sergeant Earl J. Cheevers, of the Chicago Telephone Company, one of the thirty-one men of the Prairie Division to receive the Distinguished Service Cross. The plain unvarnished tale of what Sergeant Cheevers did, reflecting, indeed, the attacking morale of the entire First Army, is told in the official report of his commanding officer, Major Gale:

I was in command of the Second Battalion, One Hundred and Thirty-second Infantry, on September 26, 1918, in the action at Forges Woods, France. Sergeant Earl J. Cheevers, Headquarters Company, One Hundred and Thirty-second Infantry, was with my headquarters as the Signal Sergeant. He was armed with a pistol. During the advance I was not certain whether my battalion P. C. was in advance of the leading wave, as the fog was very thick. With the personnel of the battalion P. C. I ran on to some trenches, which seemed to be filled with Germans. Sergeant Cheevers saw four Germans run into a dugout and without orders he rushed to the dugout, about thirty yards away. When the enemy refused to come out, Sergeant Cheevers entered it and at the point of his pistol, single-handed, brought out twelve prisoners. I consider this deed by Sergeant Cheevers one of dis-

tinguished gallantry in action, calling for personal bravery and self-sacrifice over and above the call of duty.

Let us pass from the III Corps on the First Army right, to the V Corps or First Army centre.

Here the progress was not quite so satisfactory; for to the V Corps and, more particularly, to its right wing, the 79th Division, had been assigned a virtually impossible task, namely, that of taking Montfaucon by a direct frontal attack while the 37th Division, on its left, and the 4th Division of the III Corps on its right, attempted to encircle the town and thus force the enemy to retire from it while the 79th Division pushed on and up directly through it.

Montfaucon, that almost impassable barrier which lorded it over the surrounding country like Mont Sec at St. Mihiel—that "eagle's nest," as Madelin, the French strategist, called it—was the stumbling block that held up the whole line. As a result, by the evening of the first day, when Montfaucon was to have been left far behind, the 79th Division found itself at the foot of the hill, and the endeavour to rush Montfaucon by a direct frontal attack was repulsed with a devastating hail of machine gun fire from the high-perched enemy nests. Partly as a result, the 37th Division, to the left of the 79th, and the 91st Division, to the left of the 37th, were late in coming forward.

Thus the entire V Corps, or First Army centre, found itself, at the end of the first day's operations, far behind its schedule. In the meantime, the enemy was able to rush reinforcements to the scene of action, and while the 79th Division, on the following day (September 27th), was able, at a fearful cost, to rush and take Montfaucon in broad daylight, the V Corps, and, as a result, the First Army, had been sufficiently checked in the initial stage of the offensive

so that its progress thereafter would have to be relatively slow, painful and costly, in the face of such tremendous odds and obstacles as have rarely been encountered in fighting history.

It was under such conditions that the vital strands of wire communication had to be strung to the very limits of our advance, there to be maintained and operated at all costs. Since the main attack was to be made by the V Corps, or First Army centre, the main axis of telephone and telegraph communication had to lead up through there; and to this work the 411th (Pacific Bell) Telegraph Battalion had been assigned. The activity of this battalion during these days is vividly told by its commanding officer:

That night (i. e., September 25th), Company D slept under their camouflaged trucks in the edge of the forest, and the next morning, following the main advance, was busily engaged in carrying the lead forward through the woods in the direction of Avocourt.

As a temporary measure, cross-arms were attached to trees through this forest, and insulated wire used. The roads from Avocourt to Montfaucon and Véry were jammed every inch of the way; for the first few days they were absolutely impassable for anything except the very lightest vehicles. During the day of September 26th we were able to haul some of our line material and poles and establish a dump at Avocourt, but from that point on to Montfaucon, where the first switching point was to be established, every pound of material, including the poles, had to be carried on the backs of soldiers.

Orders had been received for the building of a lead to the waterhole immediately south of Montfaucon. It must be finished on October 2nd. Its need was most imperative. About dusk in the closing hours of that date our men were strung out along the cluttered, traffic congested road through the forest, along which the circuits were being constructed. Some were pulling up slack, some were on top of poles "tying in," others distributing material from the trucks, when suddenly the "put, put, put" of machine guns was heard, and almost before any one

of the thousands of soldiers scattered along the road and all over the adjoining area realised what was happening, a number of German planes had swooped down on a "strafing" expedition. There was a hustle for cover, the anti-aircraft guns turned loose, and everyone with any kind of a weapon took a shot at the marauders.

The building of this lead across the old No Man's Land north of Avocourt, through the Foret de Montfaucon to the "water-hole" south of Montfaucon, constituted a task which tried our men to the very limit of physical endurance. Performing the very hardest kind of work in lugging materials long distances over shell-torn fields and woods, heavy with mud, soaked in almost continual rain, sleeping in recently evacuated German dugouts filthy with vermin and rats, living on scant food owing to difficulty in bringing up supplies, subjected to scattering shell fire in the day time and air raids at night, these men accomplished results worthy to be chronicled with many of the brilliant exploits in that long battle.

Reference has been made to the "water-hole." This was a natural spring of clear cold water located just at the foot of the hill south of Montfaucon, over which the Germans had built a small concrete structure, installing a gasoline pumping station. We had pre-empted this on the first day of the drive as the location for our switching station. It contained facilities for cooking, and the men who were stationed there later, operating the switchboard and maintaining the lines, were envied as having quarters de luxe. It became the rendezvous of all Signal Corps men passing to and fro, and had the reputation of never refusing a "hand-out" as long as there was anything in the larder or any chance of foraging.

Upon the completion of the lead to the "water-hole," we immediately began the construction of a 16-wire Repp lead from Véry to Ivoiry, which was to fit in with the I Corps lead being built from the left through Cheppy. This line was built along the side of the ridge extending between the two towns. The locality was still under observation by the German balloons and observation posts, and there was almost daily shell fire attracted by a battery of our "75's" located at the foot of one of the hills in front of Véry.

During the time that this construction work was being done in the forward areas, the remainder of the battalion was scat-



U. S. Official

THE AMERICAN BRAND OF EFFICIENCY

Wireless station and operators working front line trenches during battle. This station was in operation eight minutes after the American troops had left this trench for the attack. September 29, 1918.



U. S. Official

PUZZLE: FIND THE TELEPHONE EXCHANGE

79th Division Post of Command located between Malancourt and Montfaucon. The German dugout on the right was occupied by Major-General J. E. Kuhn, the centre one by telephone central, and the one on the left by the division message centre.



SURVIVORS OF "THE LOST BATTALION"

Some of the survivors of "The Lost Battalion." Lt. Maurice B. Griffin, of the Mountain States Tel. & Tel Co., in the centre.



U. S. Official

NOT A BOLSHEVIK

He merely needs a shave. Field Artillery officer telephoning back to his battery the progress of an attack.



U. S. Official

"KEEP YOUR HEAD DOWN BUT DON'T STOP"

Signal detachment, 1st Division, establishing radio and 'phone communication at Exermont, where they dug inside of the hill under shell fire.

tered over the First Army area, installing switchboards, running temporary lines to ammunition dumps, air fields, etc., providing circuits to connect with existing French lines, and operating and maintaining telephone and telegraph stations.

Having traced the progress of the American Army right wing (the III Corps), and its centre (the V Corps), during the first few days of the Meuse-Argonne attack, let us see how the left wing (the I Corps), fared in its progress.

As we have seen, the task of the I Corps was to advance up through the Argonne by means of the Aire Valley, and to keep the enemy engaged while the III and V Corps encircled the Argonne Woods on the right and the Fourth French Army encircled the forest on the left.

The I Corps, as already stated, included, in the order of attack from right to left, the 35th, 28th and 77th Divisions; with the 406th (Pennsylvania Bell) Telegraph Battalion serving as Corps Telegraph Battalion.

The progress of the I Corps, although not quite so completely checked as that of the V Corps, was also, on the whole, disappointing,—the 35th Division reaching not quite to Baulny, and the 77th and 28th Divisions, after crossing the Aire, being checked by the indescribably tough character of the obstacles encountered in the Argonne Woods.

The numerous instances of sheer fighting will and undaunted heroism that marked the 77th and 28th Divisions in this engagement were fully commented upon by the American press at the time. The achievements of the 35th Division in this action are not so well known, and yet they display a quality worthy of the finest traditions in American history.

For illustration, two instances will be cited: the first, that of Captain Alexander R. Skinker, formerly toll traffic engi-

neer for the Southwestern Bell Telephone System at St. Louis; and the second, that of First Sergeant H. G. Eckhardt, of Company I, 138th Regiment (also of the Southwestern Bell Telephone System).

We are indebted to Clair Kenamore for the following account of Captain Skinker's exploit which appears in his book:[1]

Captain Alexander R. Skinker, with three platoons of I Company of the 138th, was in position probably the most advanced of the American contingent on that side of Cheppy.

Skinker was a highly intelligent young officer, of unquestioned courage and nerve. He was noted for the care he took of his men and the lengths he would go for them. It was clear that he would lose heavily if he tried to advance through the terrific fire which was pouring from the side of the hill. The fog had nearly disappeared and he doubtless calculated it would be better to uncover the location of the guns at the expense of a few men, and conceived the idea of sending an automatic rifleman against the position, probably in the hope of reducing it by luck and skill. In choosing the men to do the trick, it would be thoroughly in keeping with his trend of thought to decide upon himself as one of them. He would not have asked of his men anything he would not do himself; he understood the Chauchat automatic rifle, and could use it if the riflemen fell, and there was no question of his own nerve. It was quite typical of him to undertake the task himself and leave his company under what scanty cover there was.

This French automatic rifle can be carried and fired by one man while advancing. He shoots from the hip. The cartridges are fed from a half-moon clip which snaps into place below the lock. A feeder walking alongside the rifleman can remove the empty "pans" and affix full ones to the rifle without losing a step.

Captain Skinker called a rifleman and a carrier, explained his plan, took plenty of ammunition and started forward to breach the Hindenburg line. Very soon the carrier was shot dead. Skin-

[1] "From Vauquois Hill to Exermont," by Clair Kenamore, pp. 113 ff. Guard Publishing Company, St. Louis, Mo.

ker took his supplies of ammunition and pressed ahead, himself feeding the rifle. Skinker fell next, killed instantly with his face to the foe and advancing. Then the rifleman was killed, and while I do not know, I like to think he was still pressing on alone.

Captain Skinker's performance was of such tremendous courage, such pure inspiration and of such calm thought, that dispassionate review of it by high officers back in headquarters convinced General Pershing that it was one of those rare deeds worthy of the Congressional Medal of Honour. Captain Skinker never knew that the nests he moved against were steel and concrete, and impervious to the fire of his automatic rifle.

The story of Sergeant Eckhardt's exploit is also related by Kenamore: [1]

There was many another deed of dash and daring. Sergeant Eckhardt believed the rifle grenade was a powerful weapon. This is a bomb attached to the end of a stick. The stick is stuck in the rifle barrel and fired. Eckhardt and Private Herbert Howard extinguished two machine-gun nests with this weapon. They attacked them simultaneously by wading and crawling through a swamp until they were in a good position to attack both at once.

And in Eckhardt's own modest language, his experience is related as follows:

The morning of September 26, 1918, the beginning of the Meuse-Argonne battle, our Division Regiment Battalion and Company happened to be the very first troops to lead the attack. Due to the shortage of officers in our company ("I" Co., 138th Inf.), another sergeant and myself were placed in command of a platoon consisting of 56 men.

After advancing for practically one-half day under the concealment of a heavy fog furnished by a Gas Regiment, we lost all means of liaison with the rest of the company on our right and the 137th Regiment on our left. Following in rear of an advancing barrage for several hours, which was supplying the fog and explosive shells, we advanced upon the outskirts of a city.

Upon general investigation it was found to be the city of

[1] "From Vauquois Hill to Exermont," p. 105.

Varenness—not to have been reached until 12:45 that day—and here we were on the outskirts at 10:45 a. m. In other words, two hours ahead of the main line which was following in the rear.

With the fog growing dim, there were but two things to do: Retreat to the main line and then advance again, or work around the city to the rear of all the fortifications which were defending the town.

After swimming and wading across the river Aire in two places, we managed to locate ourselves in rear of the town and in such a position as to make small attacks here and there upon the Boche, who, in most instances, was looking in the opposite direction. The fog by this time had completely lifted.

On one occasion a private and myself managed to crawl to one end of a small line of resistance held by the Germans. With the aid of the surrounding foliage we placed our machine gun upon a small mound at the end of the shallow trench giving us flanking fire. Failing to surrender upon the first command, three pans of ammunition were disposed of, which seemed to us to have been fired in just a fraction of a second.

The line of resistance was completely wiped out, and the few who managed to escape our fire were either taken prisoners or killed by the rest of the platoon who were in readiness some two or three hundred yards in the rear.

Working back to the platoon again, a German officer, who was in charge of this section, but who must have been out of our field of fire, located us and opened fire, killing my partner and damaging the gun I was carrying.

Being molested with machine-gun fire on another occasion, we divided the platoon into small combat units, placing a corporal in charge of each group. In this way, two other men and myself managed to clear out three machine-gun nests with rifle grenades.

On the second day of the drive we joined our company, which had suffered about fifty per cent casualties by this time. The fifth day of the drive found the battalion with but two officers and five sergeants. Reorganised, I was given a company to lead in the final attack of our part of the drive. During this advance through heavy artillery and machine-gun fire, I received a shrapnel wound in my right leg.

Not thinking the wound very serious, had first-aid administered and the leg put into a splint. Stayed with the boys until the next morning after knowing that our objective had successfully been

gained and that the counter-attack by the Germans was completely broken. After the excitement, had to be taken to the rear on account of severe pains caused by the wound received the afternoon before.

This exploit of Eckhardt's, which won for him a recommendation for the Distinguished Service Cross, took place in the neighbourhood of Varennes; and this neighbourhood shortly thereafter became one of the wire objectives for the axis of communication being built by the 406th (Pennsylvania Bell) Telegraph Battalion, in conjunction with details from the 401st (New England Bell) Telegraph Battalion. By walking most of the distance from Neuvilly, Colonel Voris, signal officer of the I Corps, and Griest, now commanding officer of the 406th Battalion,[1] managed to reach Varennes on September 28th for a preliminary survey. Beyond this point the line of advance was still uncertain. It could not be determined whether the axis would follow north along the forest of Argonne, or northeast through Baulny. When they returned to Clermont, however, they learned that Corps Headquarters had decided to establish an advance "P. C." at Côtes de Forimont.

Immediately, Price was recalled from his work on the "high line," referred to in the preceding chapter, and collecting his "P. C." gang under Cowan, hurried this group forward to a series of dugouts that had just been vacated by the 35th Division on the southern slope of the hill. Here the switchboards were installed, and the Chief of Staff distinguished the exchange by assigning to it the code name of "Bonehead."

The new open wire line had been completed to Neuvilly,

[1] Hubbell had been promoted to Lieutenant-Colonel and sent to Washington to take charge of an important training post.

at which point circuits of "twist" were cut in to "Bonehead," this work being completed about nine in the evening, with the rain pouring down in torrents.

The new home of the "P. C." gang was to be the most uncomfortable that they had yet been given. The Corps Headquarters troop had agreed to take care of their mess, but various errors were made in estimating the number of men to be fed, and blocked roads prevented the delivery of food from Battalion Headquarters, so that these men frequently subsisted on their plain fare of corned beef and hard bread.

Hannam, one of the 406th's telephone operators at "Bonehead," describes his life in that dugout:

> The headquarters in this instance were in old French dugouts penetrating the hill possibly 100 feet, well reinforced with tin roofs and walls to keep out the dampness, and, in some cases, even wooden floors. Air raids and shelling were a matter of indifference to us here; in fact, it was more or less of an amusement to stand at the front door and watch old Jerry drop them in the valley back of us.
>
> Well, if the dugouts were intrenched, so were the rats. They used to do squads right and left by battalions over the tin roof continuously, and as soon as lights were out or it quieted down, they'd come out and run over your face, chew your hair and eat your clothes; and they were ably assisted by fleas and cooties. The Germans were fighting every inch of ground above us here. Their machine-gun nests in the Argonne will always be remembered, and we were unable to move ahead.
>
> We existed at old "Bonehead" for about five weeks. The traffic jams were on roads for days at a time and mile after mile, so supplies were more or less scarce, and we ate corned beef hash and French biscuits usually. The seats of our trousers were worn out and I had a hole as big as a plate burnt in the back of my coat, but we didn't care, for the news was always good, and on our kind of job we always had plenty of it.

Passing westward from the I Corps of the First Ameri-

can Army, let us now cross over to the left of the Argonne, where Gouraud with his French Fourth Army attacked simultaneously with Pershing's First Army. As already stated in the previous chapter, Pershing had loaned to Gouraud two American divisions, the 2nd and 36th, the former including the 5th and 6th Marines.

Here the progress was even slower than that of the First Army to the right. The latter, although it fell short of Pershing's expectations, had completely amazed the enemy by its progress, which was in reality a remarkable achievement. But Gouraud, before he could make his objective, had first to bridge the gap of shell-torn desolation created three years before by the preparation for Joffre's 1915 offensive,—a territory which had again been recently ripped up by Ludendorff's Champagne-Marne preparations and Gouraud's successful defensive of July 15, 1918. In the present action, Gouraud had just about bridged this gap when Ludendorff rushed up his reserves, terminating the initial impulse of the French Fourth Army, and necessitating the same type of costly, laborious advance imposed upon the future Meuse-Argonne operations of the First American Army.

Fighting with the 5th Marines of the 2nd Division under Gouraud, was another former telephone man whose bravery earned him the Congressional Medal of Honour,—Private John J. Kelly, a boy who but a short time before was "pushing the pen" in the office of the auditor of receipts for the Chicago Telephone Company. Kelly won the highest honour the United States bestows by going through a German barrage at Blanc Mont on October 3rd and capturing a machine gun nest single-handed, killing two of the gunners and

marching back with eight German prisoners through their own barrage.

Passing, finally, to the extreme left of Foch's advancing semi-circle, we come to the British Army, attacking in the Cambrai sector, where the American II Corps had been assigned to Rawlinson's Army under Haig, and where we find our friends of the 412th (Southwestern Bell) Telegraph Battalion.

It was as the Second Corps Telegraph Battalion that the men of the 412th worked with the 27th and 30th American Divisions and with the 5th Australian Division assigned to the Second Corps. This was in what was known as the Nauroy sector, directly in front of the Hindenburg Line and occupied by the 30th Division, and the Gouy sector, taken over by the 27th Division, and connecting with the 30th Division on its right.

The defences in front of the 27th Division, which the British had never before succeeded in disturbing, were particularly strong, and comprised three very troublesome strong points known as the Knoll, Quennemont Farm, and Guillemont Farm. Second Corps Headquarters and the headquarters of the 412th Battalion were in Balloy Wood.

Here, for the first time, the Battalion became actively engaged with an attacking force that maintained a steady advance, for as the 27th and 30th Divisions moved forward, the 412th Battalion went with them. The advance took place over a gently rolling and open country, with fairly well-defined ridges that formed the main defence of the Germans. The Cambrai-St. Quentin canal passed longitudinally here through a deep tunnel known as Belle Cœur tunnel, while the main Hindenburg Line, consisting of a complication of trenches, all heavily wired, ran along the highest ridge 200



U. S. Official

PERISCOPE AND TELEPHONE

In a ruin on the crest of Montfaucon two American artillery observers direct the fire of their batteries while the shells are breaking overhead.



U. S. Official

MAGNIFICENT UNCONCERN

While stringing telephone wires across the Meuse in the face of machine gun fire from the opposing heights and hand grenades from enemy airmen hovering above. For the exploit of the telephone men of Company B, 9th Field Signal Battalion at Dun, on November 6, 1918, see page 588, giving the story as related to the author by Major Deane B. Small, Commanding Officer of the 9th Field Signal Battalion.

or 400 yards west of the tunnel. The country contained numerous German dugouts well camouflaged and exceedingly difficult to "mop up." This tunnel added tremendously to the natural strength of the German position, inasmuch as an entire division could easily be quartered within it. There were several lateral approach galleries to the rear, and numerous underground passages connecting the tunnel with all parts of the main position, which permitted the German line to be easily reinforced even under heavy fire.

Here, too, members of a Bell telegraph battalion were to learn not to take too seriously the book of Military Rules and Regulations pertaining to telegraph battalions, which had set up that a telegraph battalion's duties were to build lines of communication from Corps to Division Headquarters. As the 27th and 30th Divisions advanced and, later, as the Australian Divisions, replacing the American troops, went steadily forward, the 412th Battalion worked along day and night, stretching wire ahead out in the open, along trees, on German pole lines,—anywhere that occasion, necessity and practicability offered. Passing in and out and through the shelled area with their wires and equipment, they continued to string their long lines on ahead until immediately in back of the advancing waves of infantry.

So marked was this determination of the Battalion to keep up with the advancing troops, as evidenced by the constant presence of Battalion members in the immediate front, that an Australian officer commented on it, with the statement that he had never before seen permanent construction attempted under such conditions.

For ninety days the 412th Battalion continued at this work. During October, the Australian troops advanced to a line running from Montbrehain northwest to Beaurevoir,

continuing its advance until October 23rd, when the Second Corps was taken from the line. Several days before, the Americans Divisions had been withdrawn from the Corps for rest, having reached, at the time of their relief, the ground overlooking Catillon and the Sambre Canal. Throughout this entire period, the 412th Battalion kept at it day and night, rebuilding telephone leads, repairing lines destroyed by enemy shells, and constantly working in open view of enemy observation and under incessant shell fire.

In the meantime, while the doughboys kept pegging away at the Hindenburg Line, our friends the telephone girls who had served so brilliantly through the St. Mihiel engagement, kept plugging away at the switchboard located at First Army Headquarters. Immediately following the move of First Army Headquarters from Ligny, near St. Mihiel, to Souilly, near Verdun, the six girls who had handled the lines of communication at the Ligny board, together with a seventh, Miss Adele Hoppock, who had joined them, were rushed to the new headquarters. There were three girls from New York City,—Miss Grace Banker, the chief operator of the group, Miss Esther Fresnel and Miss Suzanne Prevot; three from the Pacific Coast, namely, Miss Marie Lange, of Colma, California, Miss Adele Hoppock, of Seattle, Washington, and Mrs. Berthe M. Hunt, of Berkeley, California; and Miss Helen Hill, of New Haven, Connecticut. Says Mrs. Hunt:

It was the experience of experiences. We packed our suit cases hurriedly, drove to Souilly, ready to do our part in the great Argonne drive which was launched on September 26th. When we arrived on September 26th, we found ourselves in a French camp that had been used for over four years, including the period of the famous Verdun drive. The barracks were flimsy things

that had been lined with old newspapers and maps to keep out the cold. The Y. W. C. A. helped us out by giving us a blanket each, a rug, oilcloth and other comforts. In fact, our sitting room (which we acquired later) was furnished with a piano and other things taken from Boche dugouts in the vicinity.

Everyone assisted in making us as comfortable as possible, considering the fact that we were in the advance area, where we could see the red and yellow glare from the shelling and feel the reverberations caused by the booming of the big guns. The 27th Engineers helped us get settled and made us shelves for our various belongings, wash stands, wooden tables and benches, etc.

At first we had charge of the operating boards only. You know with our advance units there were two types of board—that used for the ordinary routine of local and long distance calls, in regard to supplies, transportations, etc.; and that which carried all the messages between the fighting units and the commanding officers directing their movements. Every order for an infantry advance, a barrage preparatory to the taking of a new objective and, in fact, for every troop movement, came over these "fighting lines," as we called them. These wires connected the front up with the generals and made it possible for the latter to know exactly what was going on at any moment and to direct operations accordingly.

It was at the operating board, then, that we seven girls were put when we went into the Argonne. At first the four men already there, two Frenchmen and two Americans, continued to handle the local and long distance traffic. It was amusing to see them work. When a call came through in English on the Frenchman's board, the operator would motion to one of the Yanks to come and take it, and when one came to the American that he could not answer, he would call, "Hey, Frog, come over here," and Frenchy would rush around to "stop the gap."

In a short time, however, the entire exchange was handled by girls who could speak French as easily and fluently as English. Several weeks after the first group of seven girls arrived at Souilly, six more came to reinforce the little feminine army. The new arrivals included Miss Louise Beraud, of Dallas, Texas; Miss Berthe Arland, of Brooklyn, New York; Miss Jennie Young, of Seattle, Washington; Miss

Marie Belanger, of Rochester, New York; Miss Leonie Peyron, of Los Angeles, California; and Miss Maria Flood, of Chicago, Illinois.

The effect was immediate, for at a time when speed of intercommunication was of the essence, the speeding up of telephone service at Army Headquarters, especially on Franco-American calls, could not but be felt all along the line.

* * * * * * *

Such was the progress, during the first few days, of the grand assault on the Hindenburg Line, including Pershing's First American Army on the right of the Argonne, Gouraud's Fourth French Army on the left of the Argonne, and Haig's Army on the British front. Considering the nature of the country and the fearful obstacles to be overcome, the progress made was nothing less than astonishing, however it may have fallen short of the ambitious objectives originally set by the Allied commanders.

By the end of the second day, it became clearer than ever that only by a terrific and bitter struggle which was bound to prove costly, could the main idea underlying the grand attack be carried through.

During the interim, between the initial check and October 4th, Pershing busied himself straightening out his front.

On September 28th his wings (the I and III Corps) advanced a bit, and on October 1st, his centre (the V Corps) also moved forward. The 79th Division (V Corps right) was relieved by the 32nd Division, and the 35th (I Corps right) by the veteran 1st.

Everyone was now working feverishly, preparing for a resumption of the general attack scheduled for October 4th.

CHAPTER XLVII

STRESS AND STRAIN

> Looking at these successive days, the name of every hill and village will stir the memories of hundreds and thousands of men who knew in terms of sacrifice and suffering what each meant in October, 1918. These day-by-day advances, insignificant even on the largest-scale map, are the inevitable circumstance of the war of positions.
>
> —From Simonds' "History of the World War," Vol. V, p. 305.

The general attack was resumed on October 4th.

On the whole, its progress was negligible. On the First Army right (III Corps), and in the centre (V Corps), the check was complete.

On the First Army left (I Corps), the 1st Division reached Exermont, and the 28th to near Fléville; but both divisions, exposed to a pitiless cross-fire from the opposing heights, found their positions exceedingly precarious. And at the extreme left wing of the I Corps, the 77th Division, fighting magnificently, occupied a still more difficult position, for to the 77th Division had been assigned the merciless task of pushing ahead frontally through the hitherto impenetrable Argonne Forest, in the face of a veritable hell of machine gunfire from hidden nests in the heights above.

It was during this period that Major Whittlesey and his Lost Battalion earned their fame. We have had numerous accounts of the experience of the Lost Battalion, but few more interesting than that of Maurice V. Griffin, of the

Mountain States Telephone and Telegraph Company, who had been transferred from the 40th to the 77th Division, and went through the horror and misery of those days during which the Lost Battalion camped "just this side of hell":

The so-called Lost Battalion, consisting of 679 men, with other forces of the American and Allied armies, lined up in front of the forests with orders to go over the top and clear the woods of Germans. Our battalions succeeded in clearing that portion of the forest directly in front of it to a greater depth than the adjoining troops, and pushed down one hill, across an open valley perhaps 100 yards wide, and took up a position on the south slope of a hill nearly one mile northeast of Binarville.

That was on the 2nd day of October, 1918. We had gone so fast that we pushed through the German lines and they closed in on us from the rear, entirely cutting us off from our rations and Allies. Night came on and we sent our patrols in all directions. Not a man came back. On the following day a company of about 60 men were sent out to make a survey of our position. A small handful of them came back, bleeding. We then realised for the first time that we were not only cut off, but that we were in a pocket completely surrounded by the Huns.

On the second day a piece of shrapnel tore through my left shoulder, coming out of my back under the right shoulder-blade; my musette bag was torn, and a bullet was stopped by a little pocketbook in the bag. This one would have ploughed through my stomach. Another struck me in the right knee. The only souvenir of clothing I brought home was my riddled overcoat.

All our medical attention fell under the withering fire on the first day, and our wounded could only receive crude aid. We were in shell holes all the time, in groups according to the size of the hole—some held two, some four and some larger ones held a dozen men. I was on the extreme left in a small hole that two of us could lie down in. It rained almost constantly and we wallowed in mud, but the mud made our bed softer.

While we were cut off we had no rations and were forced to eat brush leaves and roots. When our supply of tobacco was exhausted we smoked dry leaves. Our water supply was mostly from shell holes, though at night some of the men would crawl out to a little slough at the foot of the hill and fill their canteens. Dead soldiers were lying all around.

The Germans crept up on us and made five attacks while we were cut off, but we silenced each attack. They were so close to us that we could hear them talking and they would occasionally throw over a hand grenade. Sometimes we could toss them back before they exploded.

We were constantly under fire of machine guns, for the enemy had located us from various directions. Six times a day we were subjected to a heavy trench mortar bombardment. Every day we could watch the Americans attacking on the hills south of us trying to break through. On one afternoon we were shelled by artillery from 2:30 to 4:30. During this bombardment the hill was shaking like an earthquake for the entire two hours. Two shells burst within ten feet of the hole I was in and we were nearly buried alive.

On the 8th day of October, after six days of isolation under constant fire, we were rescued. There were 252 survivors out of the 679 who went into the fire. Every man who laid down his life sold it dearly—every man fought to the last breath. The hour we were relieved there were less than an average of fifteen rounds of ammunition to each living man. The Germans were preparing to lay down a liquid fire attack that night and they probably would have succeeded in burning alive the remaining survivors had not succor come just when it did.

In all this experience I never saw a tinge of cowardice on the face nor in the action of a single member of the Lost Battalion. Every man expected to die, but he did not flinch—nor surrender.

Griffin's conduct during those trying days which he describes, reflecting the conduct of every other member of the Lost Battalion, is evidenced by the following citation:

First Lieutenant Maurice V. Griffin, 308th Infantry—for heroism in action west of Bois le Burionne October 2nd to 8th, 1918. Lieutenant Griffin was in command of a platoon on the extreme left of a detachment of companies of the 1st and 2nd Battalions, 308th Infantry, west of Bois le Burionne during the period October 2nd, 1918–October 8th, 1918, when the detachment was cut off from friendly troops. Although wounded severely the second day and although unable to visit his posts he still continued to encourage and steady the men close to him, and in the five closing attacks of the enemy he fired a rifle with good effect.

The splendid courage and fortitude set a fine example to his men and in a large measure was responsible for their high morale.

The precarious position of the 77th Division was due, in part, to the fact that it had advanced beyond its objective. Following instructions to the letter, it had kept up a continuous pressure on the Germans in the Argonne Woods.

A dangerous salient had been created. The 77th Division was in its centre, in the very heart of the Argonne. The other divisions of the I Corps—the 82nd (which had relieved the 28th) and the 1st, formed the right flank of this salient; and the French under Gouraud formed its left flank. These troops in the salient were being everlastingly pounded from the heights across the Meuse River on the right, and from the hills across the Aire River on the left.

There were but three things to do: Remain and be pounded to pieces, withdraw from the salient, or try to straighten it out by attempting an advance up those hills from which poured that constant rain of fire.

Naturally, Pershing chose the latter course. Between Fléville and Apremont, he threw the 82nd Division across the Aire, and this division attacked due west on the morning of October 7th. Of this manœuvre Capt. Arthur W. Page[1] writes:

What they did was one of the extraordinary feats of the whole battle. They crossed the Aire River Valley, climbed the hills 300 feet high on the other side, and by the night of the 8th had pushed the Germans off the dominating points. To pass the flat valley under artillery and machine gun fire, capture a strongly defended town (Châtel Chéhéry) get across a river and up wooded heights on the other side in the face of machine guns, is a matter not to be lightly undertaken. The men of the 82nd can, with confidence, go home and discuss war with the remnants of those

[1] "The Truth About Our 110 Days' Fighting," by Arthur W. Page, in *The World's Work*, June, 1919.

who went up Lookout Mountain in 1863, and if, on the one hand, the heights above the Aire are not as high as Lookout Mountain, on the other, machine guns are much harder to face than single shot rifles.

No insignificant part of the success of this movement is due to the splendid emergency telephone work performed by the 307th Field Signal Battalion serving with the 82nd Division. As told in the narrative of the commanding officer of this battalion, Major Kilbreath D. Schaffer, of the Central Union Telephone Company:

We reached the Argonne area on September 25th and the division was used as Army and Corps reserve until October 6th. When we went into the line, we made a flank attack between the 28th and 1st U. S. Divisions on a line along the Aire River between Châtel Chéhéry and Cornay. In doing this, we did not take over a divisional sector, and it was necessary to establish our entire wire net forward from the Divisional P. C. at Varennes. We received our orders some time after dark on October 6th for an attack at daylight the next morning. The locations of Brigade and Regimental P. C.'s were not definitely furnished until several hours later. We had no small job to establish our lines with only a few hours' notice, in a section of country none of us had seen, a black night and drizzling rain, roads jammed with traffic and no definite points furnished where lines were wanted; but when the attack started on the morning of the 7th, we had all necessary lines in service.

The 82nd Division having taken Châtel Chéhéry and Cornay, immediately began its march to the rear of the Germans in the Argonne salient, while the French, under Gouraud, having attacked eastward on the other side of the Argonne salient, joined in the flanking movement. The result was immediate: the Germans fled northward, the 77th Division emerged at the north end of the Argonne Woods, and by October 13th, the 77th and 82nd Divisions lined the

banks of the Aire north of the Argonne from Marcq to Chevieres near Grandpré.

In the meantime the opposing heights east of the Meuse had been cleared for a distance of six miles by the French, and the 33rd Division on the First Army right, forcing a passage of the Meuse River, had joined hands with the 29th Division on the Meuse Heights, reducing the other angle of cross fire which had poured down upon the American troops in the salient they had formed between the east bank of the Meuse and the west bank of the Aire.

The First Army centre, or V Corps, also advanced to Cunel and Romagne, and the American First Army was now at the foot of the Kriemhilde Stellung, where, according to original plans, it was to have been by the evening of the first day of the attack on September 26th.

To the left, with the advance of the I Corps, or left wing of the First Army, the I Corps Telegraph Battalion—the 406th—had moved its headquarters forward to a small village on the edge of the Argonne, named Locheres, then occupied by the 322nd Field Signal Battalion, and a dressing station of the 28th Division. Further on ahead, Foust's advance detachment from the 406th was still in pup tents south of Varennes, where we left them in the last chapter, with batteries of 75s ahead of them, and similar batteries to the rear, constantly vying in drawing the enemy's fire with engineers at work on the road leading toward the forest.

Despite these distracting parties, however, the forward open circuits were continued, and by the second week in October had reached Varennes. All the important circuits south of Varennes had been cut over to the "high line," and satisfactory communication was established between "Bone-

head," headquarters of the I Corps, and the advance divisions of the I Corps (77th, 82nd and 1st).

In pushing the lines forward to the extreme edge of the American advance, the 406th naturally encountered no small difficulty in securing the necessary poles from the rear supply depots. For between the latter and the immediate front there stretched a miserably inadequate roadway—narrow, muddy, chewed-up and fearfully congested. However, here the enemy unwittingly came to the rescue, for in their flight they had left behind a considerable amount of telephone equipment, which was put to good use.

The continuation of the open wires beyond Varennes, which had been turned over to Meigs, former supply officer of the 406th, proceeded forward on a basis calculated to warm the cockles of any supply officer's heart; for here, at last, was the "somethin' for nothin' " that Meigs had dreamed about. Meigs promptly salvaged a large quantity of the poles upon which the Germans had strung their camouflaged screens along the roads toward Cheppy, and in a short time, these poles were doing service between Varennes and Montblainville.

And so the "high line" was carried forward. It could not, however, be entirely finished, because there were many places, such as the valley near Varennes, where artillery fire swept the slope of a hill, making the erection of poles exceedingly hazardous, not to say useless and foolish; and on these stretches, holes were dug and poles and crossarms delivered, so that as soon as the artillery was moved to new positions, open wires could be carried through.

Meigs, with the aid of existing German pole line, had carried the "high line" as far as Montblainville. But the enemy still occupied the forest close by, and the many

machine gun nests remaining along the eastern edge of the forest, made it unwise to venture further north with the open wires. It was safe, however, for small groups to go up the line in search of new routes. Upon two occasions Colonel Voris, 1st Corps Signal Officer, and Major Griest, of the 406th, reached Châtel Chéhéry to look over the field of action, only to be greeted by the ceaseless antiphony of machine guns crackling in the woods, the burden of whose sputtering song seemed to be, "You have carried the open copper high lines as far as they need be for the present."

To the right of the I Corps, our friends of the 411th (Pacific Bell) Telegraph Battalion were busier than ever. The 411th had begun the continuation of its main army axis from the "water hole" just south of Montfaucon, referred to in the last chapter, to Epinonville, via Ivoiry, in the general northwesterly direction of Gesnes and Landres-St. George. At a point just beyond the intersection of this line and the main Charpentry-Romagne road, the utilisation of existing German pole lines began, and during the remainder of the time that this main axis was being extended, the 411th Battalion duplicated the experience of the 406th in constantly availing themselves of the use of abandoned German telephone and telegraph equipment.

The battle front had become somewhat stationary. The enemy was making a strong stand around Marcq and Grandpré. By the 10th of October the Americans had reached the Kriemhilde defence system all along the line from the Argonne to the Meuse.

This Kriemhilde defence system was approximately two and a half miles in depth. It took the First Army the next twenty days to go that two and a half miles. The hills

around Romagne, Bantheville and Landres-St. George were the backbone of the German resistance. The enemy was fighting to save his main artery of communications, the four-track line from Sedan to Mézières and on to the German rear. Through that main artery flowed the lifeblood of supplies, munitions and men for a large part of the German armies in France.

There was but one objective now for the First Army. That was to wear away the steel-and-granite resistance of the Kriemhilde Stellung by a continuous attrition all along the line from Grandpré to the Meuse River at Brieulles.

Naturally, the stress and strain of this period was felt in every fibre and nerve of the American Army. Back at Army Headquarters in Souilly, the telephone operators kept plugging and unplugging their calls as fast as their fingers could work, hour after hour, day and night, connecting up the vital strands of communication between headquarters and headquarters, army and army, backward to General Headquarters and the headquarters of the Services of Supply, forward to the very edge of No Man's Land,—tirelessly weaving the magic threads of intercourse upon whose unbroken fabric depended everything connected with the gruelling contest.

Then, on October 13, 1918, at noon, in the very middle of the straining conflict, an incident occurred that threatened to break the loom and sunder the vital strands of intercommunication for a period which, if prolonged, might well prove incalculably fatal. A fire broke out in one of the barracks at Souilly, and before it could be controlled, it spread until, in a short time, it had consumed eight barracks. Three times the barracks in which the First Army switchboard

was located, caught fire. The operators were ordered to vacate. For the first time in their overseas experience, the girls approached the limit of court-martial; for they at first refused to comply with the order. It was with the greatest difficulty that they were finally persuaded to leave their positions at the board,—only to return, an hour later, when the barracks were declared out of danger. Two-thirds of the lines had been ruined or cut, but the girls immediately started to operate those remaining.

In the meantime, the Chief Signal Officer had sent an emergency call to the front for a detachment from the 401st (New England Bell) Telegraph Battalion, to report and restore the service. Within a few hours, Companies D and E of this battalion had sent specially equipped details to Souilly, and, in addition, dispatched three trucks for new equipment to the Signal Corps warehouse at Parois, an advance "dump" that had been established by Major C. O. Bickelhaupt, of the American Telephone and Telegraph Company.

Within a few hours after the arrival of the details from the 401st Battalion at Souilly, the lines were all working again as before.

"That," exulted the officer in charge of this job, "was a Service First test pulled off by the New England men in France, that we'll back up against any Service First stunt ever pulled off at home.

Later, when the Chief Signal Officer got word of the courage and faithfulness to duty displayed by these thirteen girls at the First Army switchboard, he caused a copy of the following commendation to be forwarded to each of them as an enduring record of their work:

I. The following extract from the monthly report of the Chief Signal Officer, First Army, American E. F., for the month of

November, 1918, is furnished for your information as you were a member of the telephone unit referred to therein during the period mentioned:

"Telephone Unit, First Army.

"I desire to make of record in this monthly report the excellent work performed by the Telephone Unit assigned to the First Army and operating under Miss Grace Banker, Chief Operator. This unit has functioned with the First Army since early in September and has performed invaluable service in handling the extremely heavy telephone traffic of Army Headquarters during two important operations of the war. The Unit has lived in barracks during practically the whole time and was burned out while stationed at Souilly. During this fire the only interest of the Unit was to see that service was maintained and that if the worst came to the worst the board and equipment should be saved. A list of the members of this Unit is attached hereto for future record."

II. This commendation is noted with much pleasure by the Chief Signal Officer, American E. F., and has been entered on your record in this office.

To the rear of First Army Headquarters—throughout the Zone of Advance—throughout the S. O. S.—at the Base Ports—throughout the entire A. E. F.—the stress and strain of the struggle was making itself felt. Not a branch of the American Army in France—in England—back home—but vibrated to it. The Signal Corps Supply System, admirably administered by Lieutenant-Colonel Corlett, had been splendidly organised at the Gievres Depot in the Summer of 1918, on a ready-to-serve basis, under the immediate direction of Major Bickelhaupt, and later, had been still further broadened and systematised by Major P. K. Condit, Vice President of the International Western Electric Company. It was now functioning in a way that left little to be desired. Carload after carload of twisted pair, insulators, tape, vacuum tubes, camp switchboard sets, field telephones,—what not, would be loaded and rolled away into action at an

hour's notice. The part played during this period by the Signal Corps Supply System does not lend itself readily to dramatic portrayal, but it was none the less a vital part of the whole game.

Still further back of the line—beyond the Atlantic—the stress and strain of the final grapple was being felt throughout the entire American continent from Maine to California. And especially trying was this period for the telephone operators.

For this was the period when the "flu" epidemic was at its height. If ever there was a time when there was need to "keep the home wires humming," it was now. With traffic at its heaviest and the "flu" at its height, with the nation's afflicted and their dear ones in attendance more than ever dependent upon immediate communication with the outside world,—with the operating force itself ravaged by the dread disease,—each girl did the work of three, and the traffic manager attempting to pull the girls away from their positions at the boards, to see that they got their much needed rest, did not always meet with success.

"Any connection I make," persisted one of the girls, refusing to leave the board, "may mean the saving of a life."

And the supervisors—bless their hearts—were now called upon to prove their real worth, not merely as supervisors, but as women: for it was the period when, with all this horror of sickness in the air, the dispatches from the front brought daily messages of lives snuffed out by the terriffic Meuse-Argonne conflict which was now in progress. Not one of those girls at the boards but had a father, a brother or sweetheart at the front; and when the supervisor found a girl with red and swollen eyelids, bravely holding her position



TELEPHONE GIRLS ON DUTY

With the headquarters of the first army at Souilly, France, during the Meuse-Argonne operations.



U. S. Official

SAVE THE PIECES

Scene during the fire which broke out at First Army Headquarters, Souilly, France, October 30, 1918.



STRESS AND STRAIN BACK HOME

Telephone operators with "flu" masks. Greatly depleted in number by the ravages of Spanish influenza, with the epidemic raging everywhere about them, they bravely stuck to their tasks during the crucial months of 1918.

at the board, she knew only too well what the situation called for, and lagged not in her ministrations. It was a more than impressive sight to see these girls stand at attention to the National Anthem, failing not, in the meantime, to keep their work going at the board,—a devotion at once of the heart, mind and hand; and it was an inspiration to participate with them in the silent 12 o'clock prayer for victory that the girls never missed for a single day. No brighter page in the history of America will ever be written, than that which records the work of these American women who, during this period, often at the imminent risk of deadly contagion, stuck to their tasks on behalf of the victory that was shortly to come.

* * * * * * *

By the closing days of October, the end had become quite visible. Bulgaria had surrendered. Turkey was conquered. The Italian Army, aided by British and French forces, had delivered the blow on the Piave which resulted in the complete collapse of Austria-Hungary and an appeal for peace. Germany's peace proposal, addressed to President Wilson, had met with a response in no way assisting her crumbling morale. And now Haig's troops, including the 27th and 30th American Divisions, had emerged into the open country beyond the Hindenburg Line, and had begun to converge in the general direction of Sedan.

In the race for Sedan, they were shortly to be joined by the Americans and the French in what proved to be the final heave of the greatest conflict in world history.

CHAPTER XLVIII

THE FINAL HEAVE

THERE were many who predicted that when the break finally came, things thereafter would move to a swift conclusion; victory, gathering proportions like a snowball rolling down hill, would overwhelm the foe with the suddenness of an avalanche.

And that is exactly what happened when the final break did come. "On November 1st," says Simonds,[1] "opens the final phase. The German Fifth Army had been fought to a standstill. Forty-seven divisions have been used east and west of the Meuse, mainly to the west; thirteen of these have been used twice and two, three times. Not a few of the German divisions have actually been destroyed, and the commander of at least one has been captured, with the fragments of his division. His honourable boast it was that he had led his unit to the extreme point of penetration of the German advance both in Picardy and at the Marne. Against this formidable concentration twenty-two American divisions and four French had fought. Eleven of our divisions had been used twice and one, three times." In other words, in line with Pershing's object as expressed in his report of November 20, 1918, "to draw the best German divisions to our front and consume them," every available American division had been thrown against the enemy, every available Ger-

[1] "History of the World War," Vol. V, p. 308.

man division had been thrown in to meet them, and at the end of forty-seven days of continuous battle, our divisions had consumed the German divisions.

In this final phase of the war—the Final Heave—which began on November 1st, the task of the American Army was two-fold. East of the Meuse and in the general direction of Longwy, a drive was to be conducted by General Claudel and the XVII French Corps, acting as part of the American First Army, and including the 26th, 29th, 33rd, 79th and 81st American Divisions. At the same time, the American First Army was to strike west of the Meuse in a northerly direction toward Sedan, which was to be its objective; and the First Army was to wind up by cutting the four-track Metz-Sedan-Mézières Railroad and leaving the German Army "dangling in air."

The First Army's drive toward Sedan was to be made by the same army corps as those engaged in the earlier phases of the Meuse-Argonne,—that is to say, with the III and I Corps serving as right and left flanks respectively, and the V Corps as the centre wedge of attack.

But the disposition of divisions within the corps was to be different. On the right, the I Corps was to include but two divisions, the 5th and 90th. In the centre, the V Corps was to include the 2nd and 89th Divisions; and on the left, the I Corps was to include the 77th, as formerly, and the 78th and 80th Divisions.

The great and final stroke came off as per schedule. In the language of General Pershing's report:

> The general assault was preceded by two hours of violent artillery preparation. The infantry advanced, closely followed by accompanying guns. The artillery acquitted itself magnificently, the barrages being so well co-ordinated and so dense that the enemy was overwhelmed and quickly submerged by the rapid

onslaught of the infantry. By nightfall the Fifth Corps, in the centre, had realised an advance of almost nine kilometres (just short of six miles) to the Bois-de-la-Folie, and had completed the capture of the heights of Barricourt, while the Third Corps, on the right, had captured Aincreville and Andevanne. Our troops had broken through the enemy's last defence, captured his artillery position, and had precipitated a retreat of the German forces about to be isolated in the forest north of Grandpré.

On November 2nd and 3rd we advanced rapidly against heavy fighting on the fronts of the right and centre corps; to the left the troops of the First Corps hurried forward in pursuit, some by motor trucks; while the artillery pressed along the country roads close behind. Our heavy artillery was skillfully brought into position to fire upon the railroad from Carignan to Sedan (Metz-Mézières), and the junctions at Longuyon and Conflans.

Every part of the battle line was now moving forward with a rapidity that was in exuberant contrast to the painful period of slow attrition which had marked the previous month's fighting.

While the First Army centre and left (V and I Corps respectively) were moving northward to the left of the Meuse, the First Army right (III Corps) succeeded in crossing the Meuse at several important points. The 5th Division crossed the river at Dun, pressed forward through the forests covering the northern end of the Meuse Heights, and occupied Louppy on the Loison River, about 10 kilometres east of the Meuse. The 90th Division crossed the Meuse at Stenay, capturing the town which had once been the residence of the German Crown Prince.

The 32nd Division, east of the Meuse, crossed the Loison at Jametz and cleared the heights of the Meuse. To the southward, and also east of the Meuse, the 79th, 26th and 81st Divisions, together with the French, completed the clearing of the Meuse Heights.

To describe in detail the part played by the units engaged in supplying telephone and telegraph communication for the now rapidly advancing American lines would consume a volume in itself. The best that can be done here is to give a few scattered side-lights of what took place, as reflected in the experience of some of those engaged on this work.

For one who was not an actual observer of the rapid American advance at this time, it is virtually impossible to understand what a terrific task it was to wire up and consolidate telephonically with the back areas the rapidly increasing kilometres as they fell into our possession. Indeed, it was not always easy to tell whether the ground you were standing on was American, or still in the enemy's possession. On one occasion, when Colonel Voris, Signal Officer of the First Corps, together with Lieutenant Colonel Behn, of Signal Corps Headquarters, took an advance position at St. Juvin to note the progress of the Infantry and prepare in their minds for the signal facilities that would shortly be necessary, they were surprised to find very few soldiers around St. Juvin, and almost no sign of life in the valley between this town and the town of Champigneulles, to the north. What was the matter? They soon learned. The Infantry had been given two hours to complete the occupation of Champigneulles, but they had fallen somewhat behind schedule, and these two lone signal officers, wandering around on the slope of a hill which had not yet been occupied by American troops, were for the time being in sole possession of the enemy's territory!

In tracing the progress of wire communication during this engagement, let us begin at the extreme right, to the east of the Meuse, and work our way westward.

One of the divisions, as we have seen, operating to the

right of the Meuse with General Claudel, was the 79th. As typical of telephonic conditions within the American divisions, let us take those described by the Brigade Signal Officer of the 158th Infantry Brigade (Harold W. Webbe, formerly of the New York Telephone Company), in his report to the Division Signal Officer of the 79th Division. From this report we learn the following statistical facts, which may or may not mean anything to us: During the period from October 30 to November 7, 1918, this infantry brigade's telephone service to the rear was maintained at an efficiency of 97 per cent, and the telephone service to the front at an efficiency of $93^{2}/_{5}$ per cent. In cold, precise, mathematical terms we learn:

In taking over the telephone net, we found the system operating on a 75 per cent basis. We immediately rearranged our lines, taking them out of trenches and from stake lines, as we found this practice vulnerable to direct hits. Three lines were run to the front at about one hundred yards' interval. These lines passed through a switchboard at a lineman's relay post, where linemen, under a non-com., tested at 15-minute intervals. We detailed linemen from the brigade to the regiments to co-operate with this relay station, making similar tests and immediately working back in case of trouble. By means of the switchboard at the linemen's relay, No. 1 line toward brigade, and No. 3 toward regiment, could be cut out, and by cross plugging, two trunks could still be used. Actual figures show that in one period covering 197 hours, with lines to the front opened thirty times, service was maintained 183 hours. During the same period, we maintained service to the rear for 191 hours, with 33 opens. By means of three artillery units we had five means of communication to the rear. Lines were maintained to battalions from regiments, and in the cases of forward operations, lines were run out in advance of observation posts. Lines were also maintained with moving regiments. Exact figures are not available to show the efficiency of these lines. Records covering the period from 8 H OO, 30th October, to 20 H OO, 7th November, 1918, are as follows:

Service to the rear—97%.
Service to the front—93 2-5%.

But to get some idea of what all this actually meant in terms of personal effort, we must consult the official recommendation of Brigadier General Evan M. Johnson, commanding the 158th Infantry Brigade, to the Commanding General of the 79th Division, bearing upon what Webbe and his outfit did during this period:

1. I recommend that First Lieutenant Harold W. Webbe, 304th Field Signal Battalion, attached to this brigade, be promoted to the rank of captain.

2. I make this recommendation because of the ability, energy, and good judgment displayed by First Lieutenant Harold W. Webbe during the operations which commenced November 2, 1918. At all times, and often under most difficult circumstances, he maintained wire connection with regimental headquarters, and usually with at least one of the advanced battalions, thus enabling me to obtain information which was of material assistance in the conduct of my operations. Had it not been for the energy of Lieutenant Webbe, who personally, during the night, took out his chart and rushed forward to a provisional regiment operating far to the front, with which during the entire afternoon touch had been lost, I would have been unable to reach the organisation in time to have enabled me to make dispositions which were necessary to carry out the orders for an attack on the enemy the succeeding day.

And even yet the story is not fully told; for what Webbe did is merely an illustration of what the rest of his telephone outfit did—and the telephone outfits of every other signal unit—each according to its task. Let us consult Webbe's own list of recommendations:

1. As per your verbal order of November 14th, I am submitting the names of men who distinguished themselves during the operations which commenced November 2, 1918.

Early in the operations, on learning that a reconnaissance patrol was to penetrate the German lines, I sent Corporal George Grim, with Privates Bert Friend, Sanders Titsworth, Wilbur Anthony, William Scott, and Marion Rishel, and the necessary wire, to go forward and establish communications as far to the front as

possible. I have since been informed that from the shell hole where they installed their telephone, they could hear the Germans talking in the next shell hole beyond. These men maintained this line under heavy shell fire, and were the means of transmitting valuable information to the rear. Private Scott was slightly wounded, and Private Titsworth was seriously injured by the shell fire.

2. On one occasion, under heavy shell fire that completely cut off all communication to the front, I was informed by the corporal in charge of our linemen's relay station that the shelling was so terrific beyond where the linemen were working that it was certain death for any man to penetrate the area of fire. I called for volunteers, and three men stepped forward and volunteered to close the lines at any cost. These men were Privates William Scott, Nate McDermott, and John H. Foster. I also called for a runner, and Private Roland C. Ferris responded. When the line was closed through, the three men already cited stated they found the following men at work in the barrage: Privates George Isett, Raymond Rauenzahn, Chester Patton, and Marion Rishel.

3. I wish to mention the services of Sergeant, 1st Class, Lew L. Wallace, who had general supervision under me of all the work, and who exposed himself constantly in order that our work could be carried on with success.

4. I also wish to mention the services of the operators Corporal Orville Klingel and Privates Harry Engarde, Harry Duvall, Cecil Trowbridge, and Arthur Paulhamus, who gave diligent service during the operations.

Passing over to the left bank of the Meuse, we will remember that the First Army right, or III Corps, succeeded in effecting a crossing of the Meuse River: the 5th Division at Dun, and the 90th Division at Stenay. That crossing at Dun is worthy of a conspicuous place in the annals of American exploits during the World War. It was the common conviction that the Meuse could not possibly be crossed at this point, because the other side was heavily fortified by the enemy, and bristled with machine gun nests commanding the entire area. Those who attempted the crossing must serve



U. S. Official

NOT AS PEACEFUL AS IT LOOKS

General view of Grand Pré from the River Aire, showing portion of river in foreground and some of the field in front of Grand Pré, where American troops went across to take the town. The men are mending broken 'phone wire just cut by enemy shell fire. The enemy still occupied a portion of Grand Pré when the photo. was taken, October 19, 1918.



U. S. Official

CHANGE IN TELEPHONE SUBSCRIBERS AT VERDUN

Crown Prince moves without leaving his address. Front view of house used by Crown Prince as an observatory to view Verdun fights. Montfaucon, Meuse, France, October 17, 1918.

as perfect targets for the hidden and well placed German machine gunners.

The engineers who blazed the way with their pontoons, and the signalmen waiting to drive their reel carts across the bridge as soon as the last plank was laid, were fully aware of the warm greeting that awaited them. But they were not prepared for the sudden and furious attack that developed from the clouds above. For the engineers had no sooner got busy on the pontoons, than a flock of enemy birdmen swooped down upon the place, and began to rain down a steady torrent of machine gun bullets and hand grenades.

The toll was heavy; but it failed to stop the bold American contingents, working like beavers at the bridge. The engineers kept pegging away at their pontoons, the signalmen with their telephone lines in readiness awaiting the "Go!"

The enemy airmen, despairing of ever stopping these *verichte Amerikaner* with mere machine gun bullets and hand grenades, finally retired, taking the range back to their artillery. The wrath of the latter was promptly, accurately and fully registered in a cloudburst of shells that literally deluged the spot where the busy American contingents were at work. Men—pontoons—water covering the bed of the river—were scattered in every direction.

Promptly and unfailingly, the American contingent closed in again upon the spot. Additional pontoons were brought up, the work began anew, the bridge was completed; and the first vehicle drawn across the bridge was a reel cart of the 9th Field Signal Battalion, drawn by two horses. The reel cart was accompanied by Lieutenant John Curtis, of the New England Telephone and Telegraph Company, and a man

named Adams, from the Chesapeake and Potomac Telephone Company.

Thus was the Meuse bridged in the face of seemingly hopeless odds. In making an official photograph of this crossing at Dun—and the Signal Corps photographer, Lieutenant Humphrey Sullivan, of the Southwestern Bell System, took the picture while under fire himself—the Signal Corps could not have selected for permanent record a better typification of the spirit that won its way through the fire and hell of the Meuse-Argonne grind.

Commanding the 9th Field Signal Battalion was Major Deane B. Small, of the New England Telephone and Telegraph Company. The author endeavoured, for the better part of an afternoon, to pry loose a story or two from Small's own personal experience, which must have been replete with fascinating episode; but never a word had Small to say about himself. It was all about "my outfit—the grittiest and most ingenious bunch you ever saw. There was nothing they wouldn't tackle. And as for Yankee ingenuity, well—

At the headquarters of the 5th Division in the Bois de Tuilleries between Montfaucon and Cuissy, there was a large artillery group of the Germans, with many partially complete concrete bases and a vast amount of material for concrete construction. The 9th Field Signal Battalion was having the usual trouble with maintaining a suitable degree of installation in the wires laid on the ground. Still greater trouble was experienced by the wires being constantly broken through the passage across fields of artillery and other transport. Lieutenant John Curtis (the same who accompanied the first reel cart across the Meuse at Dun) had the particular problem of solving this difficulty.

A fat supply depot had just been captured from the Germans, and Curtis looked this over to see what it had to offer in the shape

of telephone construction and installation accessories. Rummaging around, he came upon a huge quantity of angle irons, used by the Germans for putting up barbed wire entanglements; also a considerable supply of round, half-inch rods, about 12 feet long, used for concrete reinforcements. For some reason, the Germans had already bent a gooseneck at one end of these rods. In a flash, Curtis saw his problem solved.

Using the narrow gauge railroad considerately provided by the enemy throughout this region, and also a number of trucks, Curtis had the whole supply of angle irons and rods transported to the scene of action.

To string the twisted pair through the gooseneck ends of the rods,—that was the idea. But the half-inch rods were obviously not stiff enough to stand by themselves; and to drive them into the ground would leave them too short to carry the wires above the traffic. What was done was this: First, the angle irons were driven well into the ground, then, in the angle, the 12-foot rods were lashed with the barbed wire; and thus by means of the combination of barbed wire, stake and rod, placed about 75 feet apart, wires were carried well over traffic, and for two weeks circuits thus supported were in constant use, with never a bit of trouble except when an occasional vehicle bumped into one of the supports.

Still further to the left, we find the V Corps, or First Army centre, including the 2nd and 89th Divisions, advancing with equal rapidity after the enemy in retreat. By the end of the first day, as we have seen from Pershing's report, the V Corps had realised an advance of nine kilometres, capturing the heights of Barricourt. By November 4th, the 89th Division of the V Corps had reached the village of Beauclair, five miles northeast of Buzancy.

"Within an hour," reports L. G. Lambert, of the Northwestern Bell Telephone System (fighting with the 355th Infantry of the 89th Division), "an Advance Message Centre was established, with a bearded Major shouting news back over the wires, and seeking information as to the location of units to our right and left. We had lost complete track of

these, and did not know whether we were ahead of, or behind them." And, continuing:

The shelling began to grow more intense. Soon it became a roar, the sound of one explosive overlapping that of another and almost completely drowning the voice of the Message Sender who was attempting to compete in a powerful and resonant baritone.

To the runners and small group of men comprising Battalion Headquarters, it began to be apparent that the larger share of those shells were intended for us personally, and evidently had our full address; but the Message Sender never batted an eye. He kept up his shouting, with often a command to a man outside, on the way in or out, to "For God's sake get under cover!"

Evidently he began to think that we had been located, too, as the shells were beginning to more than whisper to us; but he kept up his shouting, gesticulating, cursing and taking messages from the runners who came in now and then across the open field, dodging, on their way, only those shells that came uncomfortably close, and accepting with fine unconcern the execrations hurled at them by the Message Sender for approaching this point so openly and advertising the position to the Boche.

For once the line did not fail, unbelievable as it seemed. But no word could be obtained of the units on our right or left—neither by the telephone nor by the runner. It began to look to us as if we had outdistanced them, and were in a more or less dangerous position; but the Major kept up his shouting, which helped, at least, to keep up our spirits. Runners occasionally dodged in and out. A company commander came in to confer with the commander of the battalion, and returned to his company with orders to "Dig in," which was somewhat unnecessary, as this same order had already been given by the ungentle voices of the G. I. Cans, H. E.'s Whiz Bangs, and the rest of their screeching family.

I was called to carry a message to the platoon commander of Stokes Mortars, with orders as to where to place themselves to prepare for a counter-attack. I had just stepped out of the door of the small room in which the runners were attempting to efface themselves, started across the road, when I heard a short whistle, dropped on my face in the most approved style, and looked to see dust and stones flying from the Major's P. C. Not having any good reason for staying, and two good ones for leaving, I made

tracks for the location of the platoon which was purely imaginary, my main object being not to let any grass grow under my feet.

I returned to the P. C., to find four of my pals dead and eight wounded, Captain Fisher and the Battalion Medico among them. But the Major was still intact, and shouting over his line which was, contrary to all expectations and the law of averages, continuing to function. If ever a telephone line bore a charmed existence, that one did.

Later in the day we continued our advance, and the last I saw of that Major, he was still shouting and making good use of his line while it was working. I doubt not that he beat us to our next objective, as that seemed to be a habit with the Signal Corps men.

As we continue our westward survey of the battle line, we find the I Corps serving as the First Army left with the 77th, 78th and 80th Divisions, operating from the neighbourhood of Grandpré, Marcq and St. Juvin, northward in the direction of Sedan.

The grand race is now on for Sedan, with the object not only of capturing this historic town, but also of cutting the four-track, Sedan-Mézières railroad,—a final severance of the German Army's jugular.

Here, too, we find the movement exceedingly rapid. And, of course, the advancing American P. C.'s with all their helter-skelter jumping about, must have their telephone service.

With the construction men of the 406th (Pennsylvania Bell) Telegraph Battalion working at top speed under these trying conditions, it was not always easy to provide for all the comforts. For sometimes the advance construction crews, working immediately behind the infantry, and developing "positively unlawful" appetites, had to go for considerable periods on the well known Corn Willie diet.

Within a few days, the I Corps had advanced on either side

of Buzancy and left it behind. Thenceforth the German retreat turned into a rout. The American infantry was being carried forward in trucks, in an attempt to maintain contact with the fleeing foe. Most of the telephone circuits had been cut through the exchange at Côtes de Forimont, and Price of the 406th, with his special "P. C." gang that could establish a field exchange "anywhere, any time, and in almost no time," hurried on to St. Juvin to await orders.

They did not have long to wait. The 406th had established its headquarters here in a large stable, floored with concrete, and adjoining a former German soda-water factory; and Price with his outfit had hardly got settled, when information was received that headquarters of the I Corps would soon be established at Harricourt, near Buzancy.

Price's outfit arrived at Harricourt early that evening, and were immediately shown to a system of warehouses surrounding a recently abandoned German railhead, where the I Corps Headquarters was to be established. It was too dark to do any work that evening, and unsafe to have fires or lights, so the section immediately turned in for a rest.

A rest was precisely what they did not get. An hour later, the enemy bombing squadrons came over, and "dropped every one of their cards."

How Price's crew felt about the matter is probably echoed by Hannam, who confesses that he "would sooner go through an artillery barrage any day than to have those birds buzzing over my head again." But the deportment of these men so impressed that old Regular, Colonel Huckelberry, that he wrote:

> I may mention the fact that there was not a member of the Battalion who was gun-shy, as we are wont to say. I was thoroughly convinced of this the first night, November 8, 1918, that

we bunked in the Boche ammunition store building, near Harricourt, Meuse. It particularly appealed to me as I watched the whole of the boys as they threw their blankets down on the floor of the building between large ricks of large shells and on top of the ricks, with absolute indifference as to the probable danger that faced them, and shortly after they had arranged their blankets they were sleeping soundly as though they had not a care in the world.

Lines of communication now began reaching forward from the new headquarters at Harricourt, to the three divisional headquarters of the I Corps divisions, which were now at Authe, Autruche and St. Pierremont, respectively. The lines of communication to the rear were already built up to a point where excellent service could be given.

As fast as details from the signal battalions reached Harricourt they were set to work piecing out the German wire circuits which ran to these towns. The enemy had left behind a considerable amount of equipment throughout the warehouses and offices of Harricourt.

The enemy had also abandoned myriads of fleas and an equal number of cooties, which made the nightly conferences in the office of the I Corps Signal Officer energetic, to say the least, "and occasionally," as one of the conferees put it, "furnished a bit of excitement *on the side.*"

But one evening, in the second week of the final drive that had begun on November 1st, something besides fleas and cooties came along to furnish excitement.

The enemy had been rapidly retiring upon Sedan. The Allies were inexorably closing in. Rumours—the wildest kind of rumours—were afloat as to what was happening to the German Army.

One of these rumours, more persistent than all the others,

was to the effect that the Germans had asked for an armistice, and that one was about to be declared.

Could it be possible that this war—this long drawn-out thing that was so vivid and yet seemed scarcely real,—this living, lasting nightmare,—was about to——?

But no, it could not be. It was altogether too good to be true.

And yet the rumour persisted.



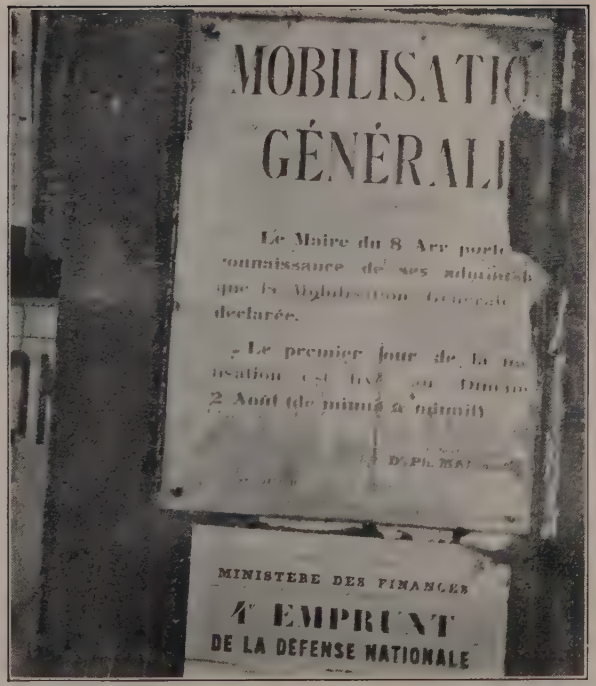
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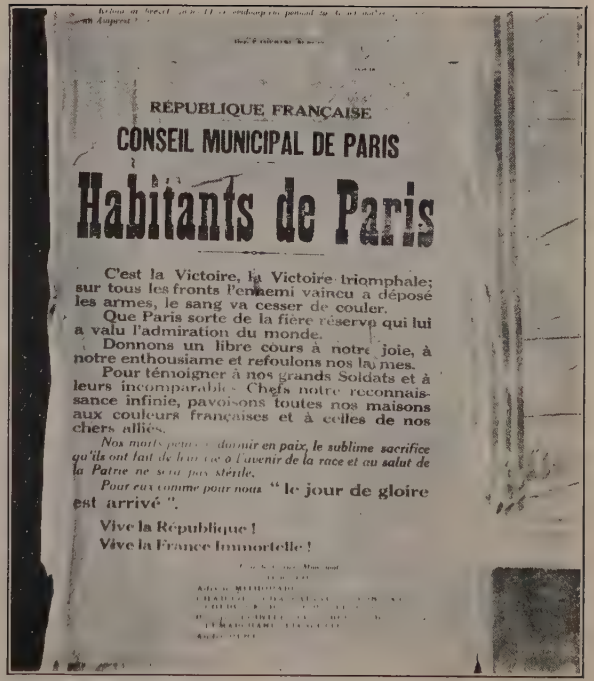
STRESS AND STRAIN



U. S. Official

ARMISTICE





THE BEGINNING AND THE END

The proclamation on the left, signed by the *Maire* of the ward, calls on the citizens to assemble for the First Battle of the Marne. The proclamation on the right is the declaration of victory, calling on the people to rejoice.

CHAPTER XLIX

ARMISTICE

For the rumour was well founded. Foch's grand finale was maturing according to original plan. On November 7th, elements of the 42nd (Rainbow) Division were on the left bank of the Meuse facing Sedan, actually astride the Metz-Mézières railroad.[1] "Armistice or Disaster," as Ludendorff had wired Berlin, was exactly the alternative confronting the enemy.

The speed of a rumour is proverbial. Carefully guarded as Armistice negotiations were, there were inevitable indications of what was coming, especially significant in the light of after developments.

Says Major Carroll Badeau, commanding the 404th Telegraph Battalion (New York Telephone Company):

During our stop at the little town of Longjumeau I received orders to proceed at once to Senlis and build a line with the greatest possible speed between that point and Paris, a distance of some thirty-five miles. This happened about the first of November.

Of course I drove to Senlis with all speed, accompanied by one of my officers, and made a rough estimate of the material we would require, the number of men we would need, etc. I came back to my own headquarters and picked out a satisfactory group of twenty men, inspected their gas masks and helmets, and got them ready. But arrangements at headquarters were evidently by no means definitely determined. Three times we started on our way, and three times we were recalled by orders from headquar-

[1] Officially it was the French who first entered the city, but the citizens of Sedan testify that the first Allied troops in their town belonged to the Rainbow Division.

ters. The last time we were recalled the men had actually left the station and proceeded about ten miles on their way, and it was necessary to recall them by sending a motorcycle courier with instructions to find them and send them back.

I did not know at that time the significance of Senlis, but the whole world has since become acquainted with the epoch-making event which took place near that town, when the German delegates, headed by Erzberger, met Marshal Foch in his private car, which had been drawn up on a railroad siding, and at 5 o'clock on the morning of November 11th, signed the Armistice which was to terminate all hostilities at 11 o'clock that morning.

Nathaniel Hawthorne tells of a renowned artist who journeyed to Niagara to paint the world famous falls, and who, upon arriving at the scene and beholding that vast, awe-inspiring display of nature's grandeur, threw his easel and brushes away in despair.

Something of the same futility is observable in the attempts of newspaper correspondents, at the time of the Armistice, to portray that overwhelming torrent of pent-up feeling that burst forth from a thousand million breasts in a wild, unrestrained tumult of celebration, as one of the bitterest and most prolonged struggles in the history of the human race came to a close. No pen can hope to portray it. All we shall attempt here is to give a few brief glimpses of that emotional upheaval, as seen through the argus-eyed wire communication system in France and America.

Let us begin at the front, and visit Captain Fred G. Borden, of the 409th (Wisconsin Bell) Telegraph Battalion, ensconced in a billet of the usual pattern: one room of a shell-shattered combination house and barn constructed of stone—stone-walled and stone-floored—and crudely furnished with army stove, bacon box and cot:

At seven A. M. an orderly entered without the formality of knocking, with an order for me to report to the Major. While

I was getting into my clothes, the orderly busied himself kindling a fire, swearing fluently at the wetness of the wood. The fire burning, he turned to me and said, "Captain, a runner from the 28th Division just came over to our steam kitchen for breakfast, and he said the war was going to stop to-day, the Germans having signed the Armistice. Have you heard anything about it?" I told him "No," and that I did not give the story much credence. Such rumors are as thick as cooties around any army camp, so I thought no more about it.

I reported to the Major, and over our breakfast of slapjacks and bacon, with plenty of black coffee (strong enough to do housework), he told me about a message that our switchboard operator had heard over the line early in the morning, to the effect that the Armistice had been signed, and asked me if I wanted to accompany him up to the line. I certainly did, and after breakfast we took my car, and drove to the north.

A detachment from our battalion was located in Vieville, about four miles north. We stopped there, and inquired of the Lieutenant in charge if he had heard anything reliable. He informed us that there was such a rumor going the rounds, but that none of the officers took any stock in it.

The Americans had mounted a naval gun of heavy calibre somewhere in the hills back of the town, and every few moments a big shell would go screaming over in the direction of Metz.

While conversing with the Lieutenant, an infantry regiment came marching in, tired and dirty.

The American batteries were whaling away as if peace were the furthest thought from their minds. They kept up a continuous roar, like the pounding of the surf.

The Major and I decided the peace rumor was some more "Bunk Information." As our Second Army passes allowed us the privilege of going anywhere, we resumed our journey northward. At 10:30 A. M., we arrived at Hannonville. Here we ran into a dense fogbank. During the last mile or so of our ride, the Boche shells had been falling uncomfortably close and plentiful. The fog cut the visibility distance down to a hundred feet or so, and the effect of the explosions was a trifle nerve-racking. We could hear them coming every minute, the Whir-r-r-r!—and then the sharp crack. There is no booming sound to the nearby explosion of a shell. It is short and sharp, like the crack of a giant whip.

The town of Hannonville had suffered severely from shell fire.

First the Americans had shelled the town to drive out the Boches. Then the Germans had shelled it after the American occupancy. The few houses that remained were mere wrecks, the streets all torn up and full of shell holes.

A high barbed wire enclosure had been a prison camp for our men, hastily constructed by the Germans.

As we pulled into the town a shell exploded, tearing away a section of the telephone line, and leaving a number of pairs of twist dangling from the cross-arms on each side. When just opposite this, a German plane soared overhead. We could easily distinguish it from our American machine by its exhaust, the explosions not being synchronised. The Boche was not high, but was obscured by the fog. The whiplike crack was coming closer, most of it in the vicinity of our trenches.

We had proceeded north a short distance, and were moving very slowly, when an officer riding a steaming horse appeared out of the fog. We stopped, and the officer rode up, saluted and said, "Major, this road is impassable and under heavy shell fire. You cannot proceed further in your car."

I ordered the chauffeur to run the car into a nearby courtyard, and we continued our journey on foot, being careful to keep well away from the road.

The crack of the Boche shells was not continuous, and our batteries sounded like distant thunder, accompanied by a thousand drums. We had proceeded just beyond the outskirts of the town, when suddenly both of us stopped.

We stared at each other simultaneously.

Something astonishing had happened, but for a moment neither of us could realise just what it was.

Enlightenment came to us both at the same instant. It was the silence. Silence profound and unbroken. Silence uncanny, almost terrifying.

We stood spellbound, speechless. I glanced at my wrist watch. It was just eleven o'clock.

The fighting had ceased. The greatest of all wars was a thing of the past.

Especially at the front, was it difficult at first to realise what had happened. It all seemed like a dream from which one might awake any minute. It was too big a Fact to be ab-

sorbed all at once. A new routine had to come into being. One had to become accustomed to a new mode of life.

Captain J. L. Vandegrift, commanding Battery C of the 341st Field Artillery, wrote to his former Boss Hill, of the Chesapeake and Potomac Telephone Company, a few days after the Armistice:

> It seems so strange to write in absolute security, free from danger of air bombs, shells or deadly gas; and the new sensations are as hard to get accustomed to, and even more so, than those of the opposite sense. No more gas sentries to awaken sleeping soldiers; no more light guards to see that the position is not disclosed at night; no more of that instinctive ducking, for there are no whiz bangs making huge holes in the air and noises like express trains.
>
> Just before communication with the rear had broken off, I had been informed that all firing would cease at eleven. At ten minutes of eleven business picked up considerably, and at two of, all Hell broke loose. It was then I had my doubts, and as I followed the second hand of my watch through those two centuries of minutes I suspected that Foch had forgotten to notify the Kaiser. But at eleven—and the Signatory Powers had synchronised their watches—all firing ceased and the silence was painful. It was a dramatic, almost a tragic, end to a horrible bombardment and, incidentally, to the war, for the war is only an incident when one is being shelled out of a position. I've often admired the toothed charm of an "Elk," and have seen the clock's face thereon. I do not know the time it tells, whether it is 5 of 12 or 11 o'clock, but if it's set at 11, I want to be a brother Elk and wear a clock, for that holy hour saved my battery from destruction.

Celebration was not always exactly spontaneous, for at certain portions of the line, an appropriate and pre-arranged ceremony, signalised by the bugler, accompanied the great transition. Captain Enoch R. Hannibal, of the 405th (Mountain States) Telegraph Battalion, tells how, "With two other officers, I was sitting in the ruins of a little farmhouse, with shells bursting all around me. The hour of

eleven was drawing nigh. The bombardment was terrific. The very earth seemed to quake and tremble, and the heavens were torn by shell and fire. It was a fearful ending of an era of blood and carnage. Then came the last tick of the watch that told the hour had arrived. In an instant the noise ceased. The hush was appalling—almost maddening. Then we heard the clear notes of the bugle, sounding taps. The world's greatest war had ended. A moment later the same bugler sounded the reveille, denoting the dawn of a new era. There the great armies of the world stood on the very hairline of division, marking the parting of the ways, and in the indescribable silence of the moment, the voice of God seemed to say, 'It is finished.' "

It was the almost universal comment at the time by war correspondents in the field that Armistice celebrations at the front seemed to lack the tumult and hilarity that characterised those in the back areas, especially the larger cities. Certainly this was not because there was any want of feeling in the matter at the front. It was rather, as Major William F. Gauss, of The Bell Telephone Company of Pennsylvania, put it, that "each man seemed to want to keep his feelings to himself, there was little room for words."

But there was an equally compelling reason for the less noisy demonstrations at the front. Facilities were less abundant. "Three of us celebrated," writes P. Ed. Fader, of the Northwestern Bell Telephone Ssystem, "by sleeping for two days in an old bookcase, seeing that there was no French wine or other ammunition for celebration to be had."

Sleeping, for them, was a celebration indeed, for especially during the month or two preceding, they had not always had the opportunity of indulging in that luxury. The night before, these very men had been subjected to an air raid.

"The Boche aviators came over in droves and gave us all the bombs they had left. They did quite a bit of damage, and some of our buddies had to go just as it was about all over.

"But," adds Fader, "we certainly did celebrate with army beans and coffee. We had them served to us in a way we'll never forget, and our cook established a record for service the world over. He built his fire over a large hand-grenade, which exploded just as we were ready to eat. We got the beans and coffee all right, but not in our mess kits. I believe that cook is running yet."

And the nights—how different they were from the nights that had preceded! The glow of campfires about the various P. C.'s, and the bright, almost startling glare from barracks windows—undarkened windows!

"The nights seemed too good to be true," writes Major Moore, commanding the 411th (Pacific Bell) Telegraph Battalion. We could scarcely visualise its meaning or realise the result. The possibility of the report being untrue—going the way of so many other rumours of a similar nature—somehow clung to us. Peace meant so much that we did not dare to be optimistic for fear of disappointment." And continuing:

> When eleven o'clock came and firing ceased, when, during the course of the afternoon, the big observation balloons were hauled down, when the short afternoon began fading into early twilight, and the big celebration of fireworks began, the realisation grew upon us that the New Order of Things had actually come to pass. We began to find ourselves, to search for something with which to make a noise, for material with which to turn the darkness into light.
>
> Shortly thereafter we started down the Meuse Valley to Verdun, the trip being made after dark. We shall never forget that trip. It was a bright moonlight night. The valley averages a mile or

so in width, with the surrounding hills jutting into the flanks at irregular intervals, and the Meuse River winding its way through the centre. We were in a mood for appreciating scenery. What had formerly been terrain, was now landscape. Camp fires built by troops bivouacked for the night completed the naturally beautiful picture. It was the first time in over four years that the soldiers had had the privilege of fires at night, and they were indulging it to the limit. There was light aplenty without the moon, for on all sides the victory celebration was still in progress, and the star shells and vari-coloured flares lighted up the sky for miles and miles. And everybody was happy; the old tenseness was gone; in its place was hilarious laughter and spontaneous, good-natured raillery hurled at everybody promiscuously.

But for the real, simon-pure ecstasies of celebration, you had to go to the cities; and of these Paris, as ever, was first.

Take the Latin temperament. Excite it to white heat. Concentrate all there is of it in France on a given point—and there you have Paris on the night of the Armistice.

Everything naturally melted before that white heat of enthusiasm. Young and old, men and women, all were converted on the instant into a blissful, care-free throng of children, frolicking happily and with utter abandon.

Midinettes marching on the arms of doughboys—of lieutenants—yes, of staid brigadiers; singing, frantically waving flags, bursting, on the slightest provocation, or on no provocation at all, into *"Vive la France!" "Vive l'Amérique!" "Vive les Alliés!"*—kissing and being kissed—drowning all rules of traffic in a ceaseless inundation of humanity on whose billows the stirring Marseillaise was endlessly tossed until, in the open spaces, as in the Concorde, it swelled into a mighty, many-voiced chorus; crowds surrounding cabs and taxicabs, rocking them as if they were mere shells on a stormy sea, or playing "Ring-around-Rosie" in a circle about their occupants,—day after day, from morning to night, the riot of

revelry held sway. For there was no Armistice *Day* of celebration: there were Armistice *Days* of celebration, or, rather, there was *no* day—*no* night—*no* time—nothing but one sustained ecstatic moment of frenzy.

That was Paris following the Armistice. The author was there. He may forget much in the days to come. He will never forget the Paris that followed the Armistice.

On the high seas, the news of the Armistice was greeted with thankful celebration expressed in a manner peculiar to the Navy. Lieutenant P. E. Tillson, U. S. N. R. F., of The Bell Telephone Company of Pennsylvania, who served on the U. S. S. *Florida,* gives us this picture of the great occasion as it was celebrated on the waters:

We had anticipated a long dreary winter at Scapa Flow, and the Fleet had already shifted its base to that point when the activity on the Western Front seemed to promise the approach of the final naval show, and back we went to Rosyth to be nearer the probable stage of action.

Here we were when the news of the Armistice was published. The despatch from the Commander-in-Chief stated that "The customary methods in H. M. service of celebrating an occasion is to be carried out by ships' companies, splicing the main brace at 1900 to-day. Hands are to make and mend clothes." Translated into English of the landsman, this meant that at 7 o'clock in the evening a double ration of rum would be served, and that the crews would have a half-holiday. The "dry" American squadron could not "splice the main brace," but it was sufficiently happy to celebrate without such assistance.

About eight o'clock things began to happen. It started up above the bridge where most of the British ships were anchored. Every siren and whistle up there opened up, scores of searchlights swept the sky, and signal rockets added a touch of colour. Our decks and those of our neighbours were black with men just waiting for the word. Soon it came, and ship after ship went into action. The "Silent Fleet" no longer deserved its name. The din was continuous. Everything that could make a noise,

except the guns, from siren to the Klaxon on the gig, was in operation. Every searchlight was combing the sky. The band broke loose and a wild "peerade," officers and men alike, snake-danced around the decks. The sacred quarter-deck was sacred no more.

Every ship in sight was doing the same and the combined effect on both eyes and ears was bewildering.

There was one impressive pause. Our ensign and those of our Allies were broken out in the beams of searchlights, and all stood at salute as the national anthems were played. Then the frolic was resumed with renewed vigour.

Taps was forgotten until eleven o'clock, when the din finally subsided and all hands turned in. So, after four years of constant vigilance, the Grand Fleet had its playtime. Still, on the following morning, conditions were as usual—ready for sea and action on four hours' notice.

America on her own side of the Atlantic, claims this distinction in celebrating the Armistice: that she was the first to celebrate. For as everyone now knows, the real Armistice celebration in the United States took place several days before the Armistice was actually signed, on the day which will ever be known as False Armistice Day. But what did a few days, more or less, matter? The essential fact was, that the enemy had been beaten to his knees, a world menace had been brought to an end, the frightful nightmare of bloodshed was over. The lid was off! Sirens, whistles, bells, horns, shouts, songs,—smote the welkin in joyous clamour: in New York, throngs parading the downtown districts through a snowstorm of paper bits swirling from skyscraper windows; in other cities, in country towns and villages, at every hearth in the land, the same unrestrained tumult of joy in every conceivable form of expression—a prolonged paean of clamourous rapture!

But in all this happy upheaval, with the whole world about them in celebration, there was one group who could not join

in the riotous festivity, because duty still held them to the firing line. They were the Soldiers of the Switchboard. In this hour of celebration, when joy and thankfulness were in the heart of each, these brave feminine warriors felt called upon to serve no less than during those days of tragedy, when many an operator, who had lost a brother, father, husband, sweetheart, had to work with tears rolling down her cheeks, or sobbing inwardly. The blaze of lights that greeted them at the switchboards a few minutes after the announcement of victory, testified that America was excitedly calling everybody she knew over the telephone, to exchange expressions of joy at the wonderful event. Without a moment's warning, traffic doubled—trebled—mounted to unprecedented "peaks"—and the Soldiers of the Switchboard remained on duty, plugging up the calls with a song in their hearts, a smile in their voices, a feeling that they, too, were celebrating this day of days by sharing in the joy of America, expressed in those countless messages of good cheer that sped over the wires.

CHAPTER L

AFTER THE ARMISTICE

Hardly had the excitement of the Armistice subsided, when an immediate call was made upon the Signal Corps for communication facilities of a character, in some respects, entirely different from those demanded by active warfare.

For the Armistice raised its own peculiar problems of wire communication. And of these, the two more immediate problems were, first, that of providing telephone and telegraph service adequate to the needs of the Peace Conference, and, second, that in connection with the occupation of enemy territory under the terms of the Armistice.

Less immediate, but in some respects no less important, were the problems of telephone and telegraph communications raised by the herculean task assigned to Hoover in connection with the American Relief Administration.

And, finally, there were the telephone and telegraph activities necessitated by the great homeward movement of the American Army in France,—the task of wiring up and maintaining communications in the rear areas designated to serve as clearing houses for that vast stream of khaki that now began to flow through the base ports back to "the land of the free and the home of the brave."

Contrary to what one might expect, telephone and telegraph development and traffic, with the signing of the Armistice, increased rather than diminished. "As a matter of

fact," observes Lieutenant-Colonel E. M. Stannard, who was commissioned in the Signal Corps from the New England Telephone and Telegraph Company, and who, about the time of the Armistice, succeeded Griswold as Director of Signal Corps Telephone and Telegraph Lines in the A. E. F., "the telephone traffic increased 25 per cent in January, 1919, over November, 1918, and the telegraph traffic 5 per cent.

As usual, the Chief Signal Officer of the A. E. F. was prepared in advance for the problems thus suddenly raised.

The report of the Chief Signal Officer,[1] says:

> Just previous to the Armistice it was apparent that it would be signed, and a conference was called for the purpose of discussing and preparing for telephone and telegraph service necessary for the Peace Conference. It was not known at what point the conference would be held, but it was thought more likely that Paris, Versailles, or Geneva would be selected. Plans were accordingly worked out so that a perfect communicating system could be established in a minimum possible time after the selection of the point. The maintenance department worked out every detail necessary for the maintenance of plant under all conditions as proposed and considered and was ready to function immediately upon receipt of definite advice to proceed. Selection of personnel was made so as to furnish men of the highest class, and this personnel was chosen from all points in France in order not to weaken or lower appreciably the standards of maintenance of the existing plant.
>
> The selection of Paris and Versailles for the Peace Conference resulted in the immediate functioning of all departments and a large force of maintenance men were at once selected and sent to Paris.

As a first step, General Russel selected Colonel Carty to take charge of the telephone and telegraph arrangements in connection with the Peace Conference.

The scene of action was the famous Crillon Hotel on the Place de la Concorde, off the Champs Elysées Boulevard.

[1] From the Report of the Chief Signal Officer to the Secretary of War, 1919, p. 194.

The Crillon Hotel had been leased by the American Government to be used exclusively for this purpose, because of its central location in the city. With its gorgeous splendour and furnishings, it offered an impressive setting. Captain J. G. Lowden, of the New York Telephone Company, was placed in charge of the installation.

Among the other telephone specialists selected for the immediate job of installing the new exchange at the Hotel Crillon was Ben H. Bear, of the Southwestern Bell Telephone System, who was at the time serving as a wire chief at Tours. He says:

The beautiful grill room of the hotel had been vacated and chosen for the operating room, and a suitable room in the basement for the terminal room. Squads, or rather battalions of men, had each been designated for the placing of cables and selecting suitable runways, for the setting up of the cross connection frames, relay racks and power board in the terminal room; for the assembling of the cabinet, multiple, relays, and the minor details of the switchboard; for the forming of the switchboard cables. Quickly the place assumed the appearance of a real telephone exchange. It seemed the desire of every man on the job to make this piece of work the masterpiece of the Signal Corps in France.

The good "old Mother Bell" (as the boys in France used to call her) and the Western Electric methods and efficiency were playing their part in the construction. No guards or sentinels were necessary to keep the men on the job or push the progress of the work. Strong and fine was the high regard for Colonel Carty; and the men would go to the mat for him.

Although the French had no telephone men on this job, strictly speaking, they were none the less on the job with a number of telephone men; that is to say, they had a number of telephone men there to see how the Yanks did the job. The functional efficiency of the French telephone system has not been perfected like our own, so it was with great wonder that the French watched the speed of our undertaking. In fact, it was quite evident that they hardly believed our work, when finished, would be serviceable. They claimed we worked too fast to do it right. The

ultimate number of stations was about 300 and the cable distribution to the sub-stations required in the neighbourhood of 12,000 feet. We planned on doing the job in a week's time, quicker than the schedule called for, but too quick, the French felt, for the job to be done right. Utter disappointment, or real surprise, was the feeling of those observers when the final cutover from the tiny French board was made and everything was found to be O. K. on the first test.

No sooner had the delegates and members of the American Commission begun to arrive, than the Signal Corps was requested to install a dictograph system of fifteen stations for the executive departments of the Commission. This constituted a separate system from the telephone exchange and a cable plant of its own. It was fully equipped with the loud speaking apparatus, so that a body of men in conference in one office could call over this system and obtain the opinion of other members of the Commission regarding certain matters.

This installation required the laying of telephone cable in the famous sewers of Paris—that Sub-Surface Paris so vividly described by Victor Hugo in "Les Miserables."

Not only was a complete new central office installed to handle the business of the Peace Conference, but also a special private branch exchange was placed in readiness to handle the telephone business of the President's residence, located in the Prince Murat mansion on the Rue Monceau. A special American-made 3-pair cable was laid between the President's residence and the Hotel Crillon, to care for the direct circuits between President Wilson and Colonel House. Inspections of this cable were made at three-hour intervals.

"Every man-hole and every wire was guarded day and night," said Chester I. Baker, of the Plant Department of the Mountain States Telephone and Telegraph Company, "to prevent spies listening in, and woe unto the Hun who was caught trying to tap the wire leading to the S. O. S. headquarters during the war. Then, when President Wilson ar-

rived in Paris, even greater watchfulness was exercised to prevent any knowledge of the private wire that connected his residence with that of Colonel House. I helped install this line and then conveniently forgot all about it. The President made his own connection or rang Colonel House, and the exchange had nothing to do with it."

And as to the operation of President Wilson's switchboard at the Paris "White House," Miss Beatrice Francfort has this to say:

> When I was chosen to take charge of the President's switchboard at the Murat Mansion, I felt that I had reached the pinnacle of accomplishment. We were established in our office there, and began a hurried preparation for the President. Naturally we wanted everything to be perfect. The three of us, Miss Martha Carrel, Miss Lillie Noble, and I got together and compiled an information book, placing in it the names and numbers of ambassadors, officials, prominent places, and anything and everything that might possibly be needed. Even at that we sometimes struck a snag, and in such a case appealed to the American or British embassy, and received from it excellent help.
>
> In calling, we used to say, "President's house," and found that it contained the magic of "Open Sesame"—to all but the French. They refused to be hurried by anyone or anything. Life is too short, and must be enjoyed restfully. Sometimes, when a message was being sent over their wires, and they found that there was likely to be some delay, they would calmly advise that a courier be sent.

That the telephone girls were popular, not only with the Commander-in-Chief of the A. E. F., but with the entire A. E. F. as well, is so well known that it needs no reiteration. Pershing, on more than one occasion, spoke very highly of the exceptional manner in which these girls had discharged their duties, and the fine *esprit de corps* and willingness to serve that characterised the operating units in France. But that the girls were equally popular with President Wilson and the



U. S. Official

"CONNECTING UP" PRESIDENT WILSON

Signal Corps telephone men installing telephone in the study of Prince Murat's mansion in Paris, which, during the Peace Conference, was President Wilson's overseas "White House."



U. S. Official

THE WATCH ON THE RHINE

Peace Missions, is not so widely known because of the quiet way in which the latter conducted their activities. On one occasion, when the President and Mrs. Wilson gave a tea to the members of their official family, he insisted that the three girls assigned to the Murat Mansion switchboard should assist the hostess in pouring tea and receiving the other guests.

The special operator between the President's house and the Elysées Palace, was Miss Mary C. O'Rourke, who assured the author in Paris, on one occasion, that she knew she stood in well with the Administration, because Mrs. Wilson always prefaced her wants with, "*Nice* little girl, will you get me, etc."

Nothing could be more characteristic of the American telephone habit, than the thorough way in which all those connected with the American Peace Delegation were made accessible to the reach of the telephone—sometimes, indeed, at the expense of privacy—a sacrifice not deemed too great for the readiness and get-at-able-ness provided by the telephone service. Because of this, relates J. G. Patterson, of the New England Telephone and Telegraph Company, a certain Motor Dispatch Sergeant has a vivid recollection of a telephone conversation with the President of the United States, which he does not care to have made part of his service record. It seems that during the Peace Conference, the sergeant was at one time in charge of assigning official motor cars to meet the various demands more efficiently. It was the sergeant's duty to call up the several garages and stands where the cars were located, and to arrange their routes. In accordance with this custom, one morning he telephoned to the Paris White House, for the purpose of getting a line on the cars that might be there. Instead of the clerk who

usually answered the telephone, the President, who happened to be standing nearby, picked up the instrument.

"The President speaking," he answered in accordance with the best telephone usage.

The sergeant, however, knew when he was being "kidded."

"Aw—go on," he challenged, "how do you get that way? You *allez* out and tell that chauffeur I want to talk to him."

The reply came back in the most dignified tones.

"But this *is* the President."

"The H—— it is! Do you mean it? I mean . . . excuse me, Sir . . . aw . . ."

And as the situation fully dawned upon the poor sergeant, he abandoned the line in haste and did not breathe freely again until he was back in the U. S. A., with his discharge buttoned securely inside his coat.

The quality of telephone service furnished the American Peace Delegation, (and incidentally, the members of the other Peace Delegations who had occasion to use the American telephone service), is still spoken of with admiration. Completed, the new central office represented a telephonic entrée to the widest stretch of European distance ever encompassed by wire on the other side of the Atlantic. It tied into a single system the nine Signal Corps offices in Paris, the other Allied headquarters, and all French commercial exchanges in the French capital, to say nothing of the constant expansion in telephone and telegraph range that was taking place during this period, while the American Third Army was moving forward into Luxemburg and Germany.

As a press correspondent put it at the time:

In Paris the French Government granted the courtesy of the establishment of a parallel American telephone system. Result,

American linemen dived into the sewers and carried their strands of copper between American offices miles apart. American electricians set up switchboards and all the delicate machinery of the telephone exchange in eight different bureaus. American telephone girls came in from the front and from the big bases at Tours and Bordeaux to clap little listening cups over their ears and jiggle the talking spark.

They even took possession of the famous Crillon bar, one-time gathering place for all the notables of the American colony and the Englishman who was loafing in Paris with guineas to spend. In just five days this home of the American cocktail and the British "B. and S." was purged of the rum demons and converted into an up-to-the-minute telephone exchange with eight "boards" and two chief operators.

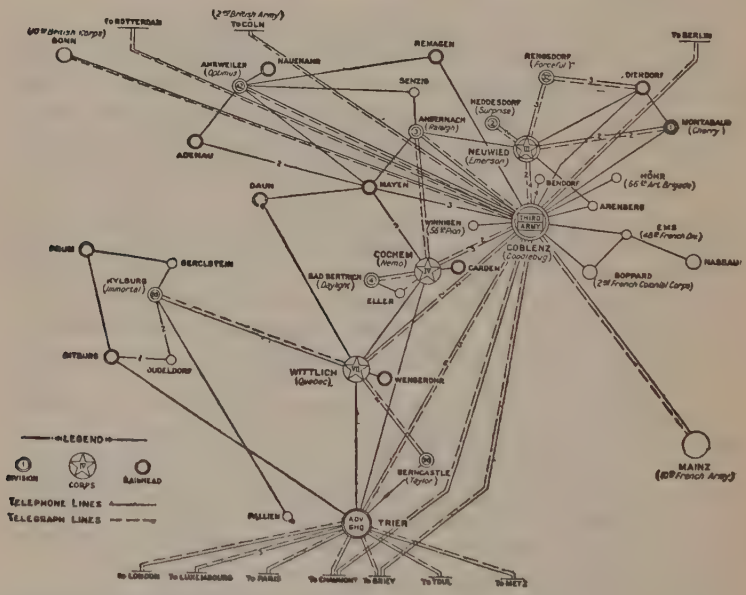
Colonel Carty took the writer down there this afternoon to show me how thoroughly the old gods of the place had been routed. There on their high stools before the maze of plugs sat eight American girls—so good to look at in their velvety cleanness and freedom from the heavy cosmetics that mark the girl of the boulevards. Miss Clara Summers, who used to be in the Broad Street Exchange in New York City, was sitting at the chief operator's desk. Everything was running like an oiled spindle; not a voice raised, not an instant of confusion as the flying fingers threaded among the green and red bound wires. Occasionally one of the operators put a question in pure French—for they all speak it—and now and then a low laugh from one of the girls marked the efforts of an unseen and gallant American to pay homage to a real American voice.

While I was in the room somebody at the "White House," where the President was living during his stay in Paris, wanted a connection with London; a call came in from Bordeaux down next to the Spanish border; an army officer at Treves, Germany, wanted to speak with his superior in the office at No. 7 Rue Tilsit. And every connection was made swiftly, surely, by those soldiers of the whispering wire.

The vast reach of the President's telephonic arm referred to in this press dispatch was not accomplished without difficulty. Indeed, the rapid forward movement of the occupying armies presented unusual difficulties with respect to the extension and establishment of wire lines of communication.

It was like a grand, successful offensive against the enemy over hundreds of square miles of new territory, with the element of military resistance, however, omitted.

It was necessary to build extensions across No Man's Land at two points, to overhaul and repair enemy military lines ahead of No Man's Land, and to establish lines for military purposes from the civil nets beyond. The main axes of communication for the occupying armies were routed from Chaumont through Souilly, Verdun, Etain, Briey, Thionville and



TELEPHONE AND TELEGRAPH COMMUNICATION OF THE THIRD U. S. ARMY, MARCH, 1919

It can be seen from the map that communication could be had from Coblenz to Berlin, Rotterdam or Paris. In fact, after certain repair work had been completed and repeaters installed, it was possible to talk from Coblenz to any point in France, and also from Rotterdam through Coblenz to Paris. While this system was being operated approximately fifteen thousand local and toll connections were established on the Coblenz switchboard daily. The volume of telegraph business handled daily amounted to nearly 2,500 messages totaling 150,000 words.

Treves to Coblenz, and from Chaumont through Neufchateau, Toul, Briey, Luxemburg and Treves to Coblenz.

These main axes were pushed forward and service established to the advance points ahead of the units for which they were provided. The army network for the occupying forces was made up largely of the military and civil lines found in the occupied area, which were taken over by the Signal Corps. In addition to providing the command net and local nets for the occupying forces, a general command net to the Inter-Allied Command at Luxemburg was established in the American area, which was extended from this area by the signal services of the Allied forces throughout their respective areas.

It goes without saying that this Inter-Allied Command net was completed in the American area prior to its completion in any of the other Allied areas. The situation as to the main lines in the occupied areas as it stood on March 1, 1919, is clearly revealed in the following:

	Kilometres of U. S. Wire	Kilometres of French Wire	Kilometres of German Wire
General Command Net for Inter-Allied Command:			
(a) Battle line to French frontier. ...		928	...
(b) French frontier to Bridgehead ...		1,240	...
U. S. Army Occupation Circuits:			
(a) Battle line to French frontier.	210	807	4,091
(b) French frontier to Bridgehead ...		...	8,910
	210	2,975	13,001

Grand Total .....16,186 km.

In extending the range of telephone communication over unprecedented European distances, American telephone men

and American telephone methods were, in some ways, put to a more severe test than during actual combat conditions. For example, there was the matter of applying the telephone *repeater* to long distance telephone transmission.

Early in December, 1918, the telephone *repeater* was installed at Souilly, for use in connection with the circuit from Chaumont to Coblenz. As the installation proceeded through the area of army occupation, and telephone officers were installed, the use of *repeaters* followed. For example, the *repeater* installed at Souilly was shortly thereafter moved to Briey, which had become the central switching station by virtue of the concentration of lines in and about that neighbourhood, so that ultimately seven telephone *repeaters* were installed at that point to care for transmission from Coblenz, Treves and Rotterdam, to the most distant points of the American system.

Now it should be remembered that up to the entrance of the telephone *repeater* upon the scene of war, this device for improving telephone transmission had been used only under most favourable conditions back home. When the *repeater* was introduced in France, no such ideal conditions confronted it. It had to be made to work, in fact, under the most rigorous conditions. The Briey installation is one of the best examples of this. Not only was this Chaumont-Coblenz circuit not a uniform or perfect one, but it consisted of a heterogeneous mixture of circuits all the way. The line from Chaumont to Souilly was No. 12 copper; from Souilly to Briey the line was partly No. 12 copper, partly the Verdun trench system, and the balance a German alloy composition used by them for telephone transmission.[1] But what is still more

[1] Following the Armistice a considerable amount of German material was captured on the line from Briey to Thionville. From this material,

interesting, in connection with this circuit upon which the *repeater* was employed, is the fact that not only was a telephone conversation held all the way from Chaumont to Coblenz, with the aid of the *repeater,* but on December 12, 1918, the day before President Wilson was due to arrive at Brest, a telephone conversation was held on the circuit *all the way from Coblenz to Brest:* a distance of nearly 1000 miles from the Rhine to the Atlantic. Over this strange collection of circuits was established the longest single telephone circuit over which a direct conversation had ever taken place in Europe up to that time.[1] This historic first telephone conversation from the Rhine to the Atlantic, was held via St. Nazaire, Tours, Dijon, Chaumont and Briey.

Early in the Spring of 1919, the French Department of

including German poles, German wire, German insulators, and the like, a complete German standard line was erected by the 403rd, 404th and 408th Telegraph Battalions (from the Chesapeake and Potomac, New York and Northwestern Bell Telephone Companies respectively.)

Every part of that line was salvaged from German apparatus. In other words, since what these American telephone men had available was German material, they simply went ahead and built a German line as good in every respect as a similar line that might have been built by German telephone men familiar with their own material and apparatus.

The account of the battalion historian of the 408th Telegraph Battalion, as to this, is as follows:

"The last work of importance done by this battalion was on the Briey-Thionville (Lorraine) project. Here, with the assistance of the 403rd and 404th Telegraph Battalions, an American lead of sixteen copper circuits, designed in accordance with German specifications, was constructed. This work, while not of great military importance, will always be remembered as the closest to Berlin permanent construction put up by the American Signal Corps. It completed an All-American line from Bordeaux to northern Lorraine, with a line mileage of approximately a thousand miles. It was at this place that the American lines connected with the German, giving through telephonic and telegraphic connections, via Treves, to the American Army of Occupation on the Rhine, and from there on into Berlin itself."

[1] The subsequent Paris-Rome direct telephone conversation established another long-distance record in Europe, the distance being even greater than that from Coblenz to Brest.

Postes and Telegraphs was asked by the Chief Signal Officer of the A. E. F. if they wished to send men around to the different American Signal Corps offices, to receive instruction in American telephone equipment. The French postal administration was inclined to be lukewarm in the matter, and the invitation was not pressed. Then, when the lines from Coblenz south towards Chaumont were turned over to the French, the American Signal Corps, of course, cut out the telephone *repeaters,* leaving only the bare wires cut through. A few days thereafter Marshal Foch, attempting to use the telephone on these circuits, received a jolt. The clear transmission to which he was accustomed was lacking. The Marshal lost no time in getting in touch with the French Department of Postes and Telegraphs. A heated conversation ensued. As Marsters, of the American Telephone and Telegraph Company, puts it:

> He let them have it hot and heavy, and told them they would have to put the wires in just as good talking condition as the American Signal Corps had previously maintained, or he would like to know the reason why.
>
> About two or three days afterwards, three of the P. T. T. engineers showed up at Tours, all excited, and asked us to help them out. This resulted in a Telephone Repeater School, which I held in July, 1919, at La Belle Epine, for the French army and civilian telephone men. We had on hand each of the different types of sets of *repeaters* shipped to France, and a week was spent explaining the circuits and going over their operation.

During the Peace Conference, it became essential to improve transmission between Paris and Rome. The Italians had a large gauge circuit running between these two points—larger, in fact, than the wire used on the transcontinental telephone line in the United States, although the distance was only one-fourth as great as the distance between New York

and San Francisco. But they could not carry on a direct conversation over the line.

Captain O. B. Jacobs, Signal Corps, of the American Telephone and Telegraph Company, was sent down to Turin, where he installed a telephone *repeater*. The result was that "They literally made Rome howl," as Colonel Carty observed a year later, "because the talk from Rome came in so strong at Paris." The Italian officers, amazed, begged that the American Signal Corps turn over to them immediately one-half dozen telephone *repeaters* for their circuits throughout Italy.

The actual installation of this first telephone *repeater* in Italy was not wholly devoid of incident, as told by S. D. Ricciardi, of The Bell Telephone Company of Pennsylvania, who was engaged in the immediate work of installation under Jacobs:

During the peace negotiations in Versailles, the Italian Peace Delegation found it expedient to use the telephone for transmitting the day's proceedings of the Council to its Government seat in Rome. To this end, a toll line between Rome and Turin, and the international line between Turin and Paris, were pressed into service. The Rome-Turin line traced a course along the western coast of Italy, parallelling the Mediterranean Sea for some thirty miles. The Paris to Turin leg crossed over the Alps Mountains, routing through Modane, Lyons and Paris. A glance at the map will show that the route taken by these lines was not the most favorable from the standpoint of insulation, etc. (During my stay in Turin, the lines went out of service on an average of five times a day.) Then, from the great distance between Rome and Paris, it would be natural to believe that conversation was impossible on an unloaded line. But service was urgent and some means had to be gotten to serve the purpose. To this end, the telephone authorities made Turin a relay point, and asked the military authorities to place its personnel on the job for the purpose of relaying messages. Thereby you have the human repeater, receiving messages on a wall set associated with the Paris-Turin line, and transmitting, *by word of mouth,* through another

wall set associated with the Turin-Rome leg, and vice versa. Judge for yourself the accuracy and efficiency of such a system!

It was this inefficiency that sent us to Turin with an emergency type *repeater* to facilitate telephone communications, thereby speeding up, indirectly, the drawing up of the Peace Treaty destined to officially end the great war.

The *repeater* installed, showed a gain of 12 miles of standard gauge cable and everything working lovely. During the trial tests many amusing incidents occurred. The Italians were somewhat skeptical. They believed in the telephone *repeater* in theory, but doubted it in practice. To show that there was a gain, they were permitted to monitor the calls and to note the volume and quality of the human voice by repeatedly cutting the *repeater* in and out. We were making such a test at 12:00 one evening (we worked until the wee hours of morning to put the instrument in immediate operation) and for lack of "subscribers" on the ends, we asked the operators at Rome and Paris to converse with each other. Here we received a shock, as the operators did not speak a common language. We would turn to Paris and ask her to "Causez avec Rome," and to Rome, "Parla con Parigi." Then a confusion of voices, as Rome bellowed "Pronto! Pronto!" through one end, and Paris with her "Hallo! Hallo! Hallo!" through the other. In desperation, we politely asked the Paris operator to sing "La Marseillaise" to Rome. To our amazement the French mademoiselle responded nobly, and rendered us the French national air with all the fervour she possessed.

The results obtained with the *repeater* were very satisfactory, and ere three days passed, we were requested to adjust the *repeater* so as to switch it on other lines as well. A temporary arrangement was designed and made up with the result that a through line *repeater* was transferred into a cord circuit *repeater*. So pleased were the authorities with the results obtained that immediate steps were taken to not only purchase outright the *repeater* already installed, but to purchase others for other lines throughout the country. I have not been informed of the fate of that little portable type *repeater* we installed, but firmly believe that it will mark the beginning of a great change in the present Italian telephone system, that is characteristically the same to-day as it has been in many years gone by.

Demands not only from the Peace Conference, but from

the U. S. Navy, and from Hoover's Food Commission, began to require the presence of Signal Corps men in strange places.

Major Frank H. Fay, whose part in the upbuilding of A. E. F. telegraph service has already been outlined, was sent by General Russel to Venice in February, 1919, to report to Rear Admiral Niblack for the purpose of establishing electrical communication along the Adriatic coast from Trieste to Cattaro. Said Major Fay:

I had no idea what kind of communication was to be established, except that it was to be electrical. So I took with me a quantity of material sufficient to supply me for ordinary purposes with the necessary equipment for a telegraph line, and, in case that did not prove feasible, for the establishment of at least a buzzer system of communication.

When I got to Venice and attempted to make arrangements with the proper Italian authorities, I was informed that there was absolutely no extra circuit available; that every Italian circuit in the neighbourhood was overloaded. Naturally I continued to scout about. Finally, at Pola, I got in touch with a Czecho-Slovak in the Polish telegraph office. The Czecho-Slovak knew no English; of course I couldn't speak their language; and the interpreters didn't know a word of English either. But I had a smattering of French—A. E. F. French—and we managed to arrive at an understanding.

The Czecho-Slovak informed me, with a chuckle, that there was a submarine cable in excellent shape that none of the authorities appeared to know anything about. It had been a German cable, and was 303 kilometres in length. It was a find!

I immediately appropriated this cable, which ran all the way from Spalato to Pola. The Czecho-Slovak further informed me of an excellent overland telegraph wire, which was absolutely idle, running from Pola to Trieste. "The Italians," he said, "know nothing about this. I—only I—know. You shall know, too—you are an American." And so I promptly arranged to take this over, too. I connected it up with the submarine cable that I had in the meantime equipped for service (with land-line instruments!) and the line was through from Spalato to Trieste.

The Navy was immensely pleased with this new line of

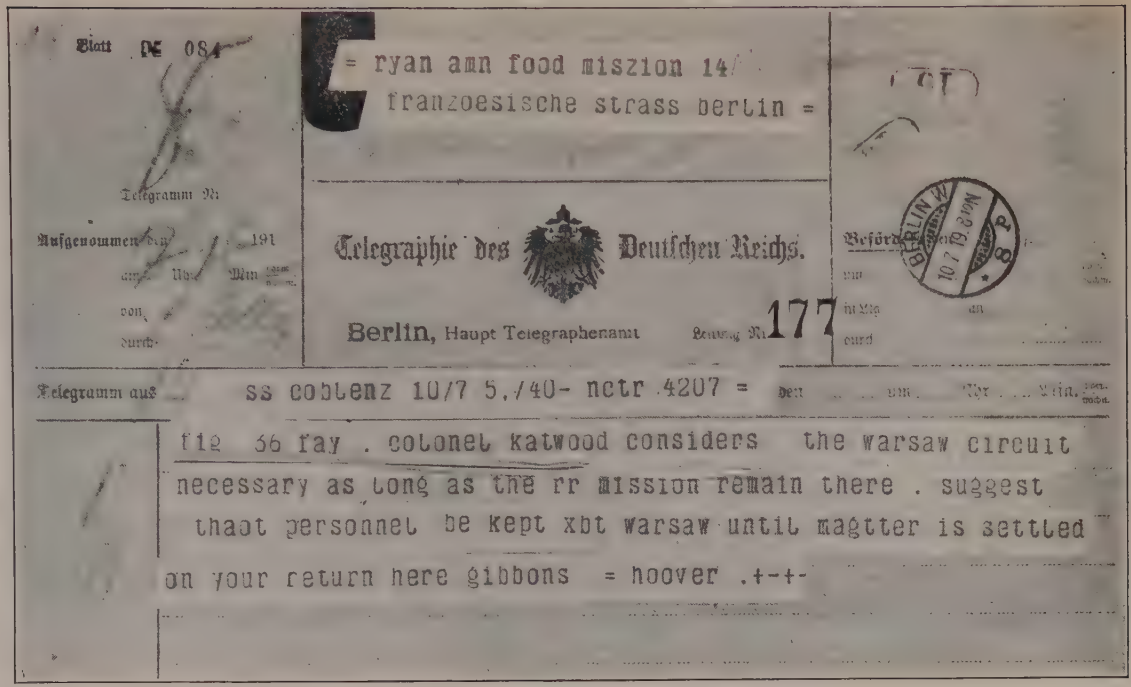
communication which had been virtually "dug up," resuscitated, and put to excellent use.

The Food Commission, too, which had begun to assume grave importance in the new European order of things following the Armistice, was experiencing great difficulty in communicating with their representatives. This was due not only to underlying political conditions, but to what amounted, in some places, to a chaos of electrical communication. Here again the Signal Corps assisted by sending detachments to open communications at various points, or by providing trained personnel for service at important points in Europe to establish, supervise and operate the wire service required by the Commission.

Later, when Major Fay became Superintendent of Telegraph for the American Relief Administration, the wire communication system in Europe was still further enlarged by the establishment of telegraph offices at Vienna and Hamburg, whence, via Coblenz, direct communication could be had with Paris. Fay also visited Berlin in connection with a proposed telegraph office in that city, but the project was dropped.

Even the home of the Moslem was invaded. During the Summer of 1919, Fay sent one of his assistants, Lieutenant (later Captain) D. H. Woodward, of the Southern Bell System, down to Constantinople to procure all the data he could possibly get in reference to the telegraph lay-out in and about Constantinople and the Caucasus.

When Woodward got down there he discovered a curious circumstance. A cable running between Constantinople and a portion of the Caucasus in the hands of the Bolsheviki was perfectly intact, and communication from one end of the line to the other uninterrupted. Every morning one of the Brit-



ENGLISH AS SHE IS "GESPROCHEN"

Specimen telegraph message sent over German telegraph lines by German operators during the period of occupation.



U. S. Official

BATHING UNDER DIFFICULTIES

Member of the Signal Corps, attached to the 27th Division, taking his monthly bath.

ish signalmen at Constantinople would call up Odessa at the other end of this line, and exchange the usual technical greetings with the Bolshevik operators at Odessa. It was not exactly a social tête-a-tête, but in a way, so far as this particular cable was concerned, the Bolsheviki and the Allies at Constantinople had a working armistice. Both were anxious to see that nothing happened to the working order of the cable. They were, apparently, telephonists first, and combatants only incidentally. Except for this morning interchange of technical greetings by way of test, this cable was absolutely unused.

Concerning a mission to Italy on behalf of the Food Commission, Woodward relates:

Telegraph and telephone communication was established at all the principal points along the coast, including Trieste, Fiume, Spalato, Ragusa, Zelinika, and Antivari. Made the entire trip down the coast to Zelinika without passports in automobiles and in charge of a party of Signal Corps soldiers, including interpreters, installers and chauffeurs. Was on this work for two months, and experienced several exciting moments, on account of the strained relations between the Italians, Jugo-Slavs and Serbians. Was suspected of being an Italian spy at Gospec, and together with entire detail, made prisoner by the Jugo-Slavs. Demanded that the matter be taken up immediately between Jugo-Slav Headquarters and American Headquartes at Trieste, and succeeded in obtaining release after ten hours, and with many apologies.

Shortly after returning to Trieste, was ordered by the Food Commission to proceed by automobile to Belgrade, to establish communications between that point and Bucharest. En route from Fiume to Agram, on this mission, serious trouble developed which necessitated a return to Fiume, and on reaching there found orders from the Chief Signal Officer to return to headquarters in France.

* * * * * * *

Such were the problems confronting the American Signal

Corps in France following the Armistice: the main communication problems raised by the Peace Conference and the Army of Occupation, and the incidental activities in connection with the U. S. Navy and the American Relief Administration.

In addition, there was also the problem of wiring up those back areas which served as clearing houses for the grand homeward movement that took place, when an army of two million homesick warriors turned their faces once more to the western horizon.

CHAPTER LI

DELOUSED, DEMOBILISED, DELIGHTED!

"I don't regret my experience; I suppose I would go through it again if necessary. But I don't want to lie about it; I didn't exactly enjoy it, except on the theory of the man who enjoyed pounding his finger because it felt so good to quit." —*From a statement by One of Them, which is believed to reflect the sentiment of Most of Them.*

"Had not the Armistice intervened," writes one of the members of the Pacific Bell Battalion, "the 411th would have established another record; for when we returned to Verdun and were able to bathe, many men lacked but four days of being able to sew a service stripe on their underwear. Naturally, we were all *itching* to go home."

And that, physically or mentally, was the way most members of the A. E. F. felt about it. Now that the war was over, they were just itching to get home. Immediately after the Armistice, the bottom seemed to drop out of all effort. In place of the high pitch and continued strain, a deep sag of apathy prevailed: "The war's over—what's the use?"

And yet, besides the work assigned to the Army of Occupation, and the task of establishing world peace on an enduring foundation, there remained—what was no small a task in itself—the problem of demobilising, in an orderly, efficient way, an army of two million men located more than 3000 miles from home. Many would have to stay in order that most might go. And the first task was, to effect an ade-

quate wiring up of the rear areas which were to serve as clearing houses for this enormous homeward movement.

For it *was* an enormous movement: an exact reversal of that tremendous stream of khaki that had poured across the Atlantic by the hundreds of thousands during those crucial months of 1918 when the fate of the world still hung in the balance.

By the end of 1918, 125,000 troops had embarked for home. An almost equal number sailed during the month of January, 1919. By the end of March, 1919, more than half a million men had returned, and within the next five months almost the entire army of two million had been safely landed on their native shores.

More than half of these troops—52.5 per cent to be exact—passed through Brest on their homeward journey, and somewhat over a quarter of the total sailed from St. Nazaire.

It is therefore not surprising that by far the largest wire communication problem in connection with the great homeward movement of the A. E. F. was encountered at Brest, with St. Nazaire second.

Months before the Armistice, the 410th (Central Bell) Telegraph Battalion had been assigned to the work of wiring up the area in and about Brest. The French Telephone and Telegraph System having proven inadequate to handle the A. E. F. traffic between Brest and St. Nazaire, the 410th Battalion had completed an American pole line between these two leading base ports of the A. E. F., to be used for long line telephone and telegraph circuits. The battalion had begun the work on September 9, 1918, with Company D located at Brest and Landerneau, and Company E, together with the headquarters detachment, at Quimper. Inasmuch

as it was necessary to carry on this work in conjunction with lines being constructed for the Navy, approximately 200 sailors were attached to the battalion as labourers.

By the time the Armistice was signed, the system had been built up to a point where it was rendering splendid service. But by that time, also, the new problem of demobilisation arose, and this involved especially the question of telephone and telegraph service not only at the Port of Brest itself, but also at the now famous Camp Pontanezen.

During the early part of the war, telephone service at Camp Pontanezen had been carried on over two trunk circuits leased from the French and running from the switchboard at Brest to a small magneto board at the camp. These circuits were soon swamped by the rising tide of A. E. F. traffic. Two additional trunks were run from U. S. Army Headquarters over the main Brest-St. Nazaire line, to a point where the Pontanezen road and the Rue de Paris meet, thence to Camp Pontanezen on a "ten-pin arm lead" erected on French poles. These facilities were sufficient until the early part of November, 1918, when the wind began clearly to blow in the direction of an armistice.

Immediately after the Armistice, Major C. O. Bickelhaupt, (of the American Telephone and Telegraph Company), was relieved from the staff of the First Army and designated as Signal Officer of the Brest area. Bickelhaupt set to work at once to rearrange the entire telephone system in and about Brest.

Those were busy days for the 410th (Central Bell) Battalion. New switchboards were installed, new cables laid practically over night to take care of the new U. S. Army Headquarters and the rapidly enlarging administrative machinery for moving the A. E. F. home, and the result was a

system of telephone communication as complete and efficient as if it had been located down in Wall Street.

The ease and facility, the almost clockwork regularity and dispatch with which things moved at Brest during these months of demobilisation, were the subject of frequent comment by returning officers and soldiers. And as usual, it did not occur to many that a large part of this was to be found in the hidden forces of wire communication quietly operating behind the scenes.

Thousands upon thousands, they came streaming into the French ports, burdened of back but lightened of heart; for they were on their way home. Somehow, the pack seemed to have lost its weight. As a matter of fact, its weight had in most cases increased. For what American soldier was without his souvenir? And in some cases these souvenirs were no mere trifles. Probably the largest souvenir acquired by any member of the A. E. F. was that cachèd and carefully treasured by Corporal Frace of the 411th (Pacific Bell) Battalion. It consisted of a complete set of German harness!

One thought—one single, solitary thought—was in each man's mind: HOME. The most confirmed vagrant of former days now felt the pull of the hearth. With some, especially with those whose homes for the past two years had been ceilinged and walled by subterranean mud, with rats and vermin for constant companions, that tug toward the old hearth set up a yearning that is well-nigh indescribable. Mere homesickness does not begin to express it. Some conception of it may be derived from the following little monologue conducted by Peterson, of the 406th (Pennsylvania Bell) Telegraph Battalion, switchboard operator in the dug-

out at "Bonehead," headquarters of the First Army Corps. The sole audience is Peterson's only companion: a rat.

Time: Sunday afternoon—1 o'clock.
Place: Our little (homelike?) dugout.

(*The hero sits on the lower deck of a pair of bunks with a well-worn bench pulled up to him. Candle and writing materials on the bench. Clothes, towels and accoutrements hang promiscuously about. A rat is playing hide-and-seek between the supports and the iron ceiling. The hero speaks to the rat in a light, musing manner.*)

Well, old timer, here we are all by ourselves. The boys are out pulling wire and you and I are left here all alone. Oh, I see that snicker on your face: you'd be a lot better satisfied if I went out too, so you could come down and look through my stuff and see if I brought anything good to eat in lately. It's no use, boy, I ate that candy just about as quick as I got it yesterday, and cried for more. You'll have to double-time if you want to beat me at that. You little bum, you wait till a fellow puts his lights out before you come out in the open.

Say, did you see that party we had this morning? You sure would like to have been in on that, I'll bet. They were the best hot cakes I've eaten since I left old U. S. A. Yes, we had to thin out the molasses a good bit to make it go around, but she sure went good, and listen, bo, if we don't get the ambition to clean up that batter can, you can have what's left. No, the molasses is all gone, but you better be glad to get the batter. Why? Because we're going to light out of these parts before long. Sure, and you're going to starve to death when you don't have two governments to pay your board bill. . . . No, there's not going to be any more soldiers around here a-tall. What, didn't you hear the news? Why, the Boche has given the war up as a bad job. Found out that he didn't know as much about it as he thought. He's trying to duck out now, get out from under; maybe we'll let him and maybe we won't, but anyway you take it, he loses. So, old timer, you'd better prepare for a hard winter. Yep, that's the reason I've been sitting around here all morning doping it over. Yes, sir, it's well over a year since I've been home and sometimes it seems like ten. . . . So this morning I just took a little ride over the briny. You've never seen the Statue of Lib-

erty, old boy, and you've sure missed a lot. She's about the best piece of scenery that ever a man looked at. . . . But after I passed her I never looked back. I had my eyes on the dock, where we landed. I crossed the ferry and hopped a train and landed in Broad Street Station, Philadelphia, in nothing flat. And there's another sight you've missed, old boy. You think us fellows are just a big edition of yourselves and that we don't know anything else but holes in the ground. Well, you've got a lot to learn. If you could just see Broad and Chestnut once, those little beads in your head would pop out like splinters from a shell. Well, boy, I had mighty important business on hand, but I just stood there for five minutes gazing in every direction and she was all there, not a single shell hole in the street and not a splatter of nicks and busts in a building, nor a pane of glass missing. And a million pretty girls around—but when I noticed them I jumped quick, for my business came back to me. I hopped on a train and went through a big rat hole that makes yours look as small as a flea on an elephant; crossed the river and hopped in a taxi—some of those trolley cars are awful slow. I watched the old landmarks whiz by, sorta surprised that they were still standing, and looking just the same as a year ago; in fact, I began to wonder if I'd been over here with you fellows, in the biggest war in history. It began to fade like a dream . . . the Court House, Minger and Long's, Hinsky's, the Armory, City Hall, Kaighn's Ave., little ole Harleigh, Browning Road, Hill Crest, Crestmont, —Hey, Hey, there, chauffeur, whoa, wait a minute, turn to the left, look out for No. 121. . . . Yes, sir, old rat, there she stood, just as I left her. I was sorta expectin' to see her a different colour, that old chocolate brown pretty well faded out, and I heard she was gonna be painted this month, but she looked good, for that's my home, old rat! There ain't no use you tryin' to imagine it and shinin' your eyes at me that way, and duckin' around the corner as if you were tired listenin', 'cause I'm gonna spin this yarn to the end; you've never seen anything like that little old house, and never will as long as you stay in this country.

Well, old rat, I forgot the chauffeur and that little ole taximetre, and ran up those steps in one hop. Rat, you'll never have anybody so glad to see you as they were! They hadn't finished breakfast yet, but my Peggy was there anyhow. I can't go into all the details, old boy, you wouldn't understand them, but Mother, Dad, Sis, and the Girl were all there, and they were just cleaning up



U. S. Official

ACCURATE NOMENCLATURE

"Had not the Armistice intervened," writes one of the members of The Pacific Bell Battalion, "the 411th would have established another record; for when we returned to Verdun and were able to bathe, many men lacked but four days of being able to sew a service stripe on their underwear. Naturally, we were all *itching* to go home."



Photo from Western Newspaper Union

"HELLO, OLD GIRL!"

In the mind of the overseas veteran there is no question as to what is the greatest statue in the world. The unanimous verdict is in favor of "The Old Girl on Bedloe's Island."

a bunch of hot cakes. Ha, that makes your eyes shine, don't it? And listen here, varmint, they weren't the kind we had, made of flour and water with watered molasses on, but flour and milk, with some sugar in to make 'em brown, and butter on 'em and real maple syrup, and they were on china dishes and the dishes were on a white cloth, and the sun came trickling through the curtains and glinted on silver eating tools. Ha, ha, you poor misguided rat, you're going back to your hole. You think I'm pulling some soldier bull on you; goes to show you never lived any place but a dugout. You want to snap out of it and get out in the world where people live and see something. You don't believe either, I guess, that anybody would leave a feed like that just to look at me, do you? Well, they did. They forgot all about eating, just to listen to stories of this business over here, but I said I'd rather tell 'em about it with a mouth full of those hot cakes, and wet my whistle with some of the best coffee in the world—*au lait*, too. . . . You can put your hat on now, old rat, I'm through. I had to come right back here to see that old Bill Hohenzollern didn't pull any tricks on us, at the last minute. He better not. He's getting off d—— easy if he takes what he's asking for, and if he tries to take the jump on us, he'll be cutting his own throat. But remember what I told you, you'd better be looking up a home for yourself where your grub will be more permanent. So long, I'll see you to-night; no hard feelings, and don't take any wooden money. - - - - - - - Curtain.

Peterson's dream came true at length. In due course his battalion, crowding the lighter which carried them from French soil to the waiting transport out in Brest Harbour, while a "jazz-band" played lively airs on shore for the send-off, watched the shores of France recede—less with pangs of regret at departure than with joyous anticipation of viewing again, before many days were over, the Lady with the Lamp rising majestically from Bedloe's Island. One after another, the Bell Battalions embarked for home. The first to leave was the 412th (Southwestern Bell) Battalion, which arrived home on March 15, 1919; and the last, the 410th, from the Wisconsin Telephone Company, whose duties in Brest re-

quired that they stand by on the wire communication job until the rest of the "gang" had left, so that this organisation had to postpone its homecoming until July 7, 1919.

And what a difference between the homecoming and the departure! No lurking submarines to dodge, no rigid rules to preserve the blackness of the night, no uneasy speculation about new duties in the world of doubt and uncertainty that lay in the vicinity of the battle field—nothing but the sheer joy in anticipation of the warm greeting that surely awaited the wayfarers at their journey's end—the brightest, sunniest, happiest part of the globe—God's country! Had you listened to the cheerful, lighthearted groups of soldiers, enduring without a murmur the discomforts of the crowded homeward voyages, what would you have found to be the topic of their conversation? What they had done in the war? No indeed! Instead, "What I am going to do as soon as I get out"; "Believe me, but I'm going to get *some feed* when I hit New York"; "O boys, won't the American girls look good!" etc., etc. A spirit of good cheer pervaded everything, and the only disturbing element was that no ship could travel fast enough to keep up with the homeward-speeding thoughts of the boys.

And when, at length, land was sighted and the transports, bearing their human burdens, each thrilled with the delight of a safe return, headed slowly up through New York Harbour, past the Statue of Liberty to Hoboken, past the tugs, ferry boats and other harbour craft whose riotous tooting mingled with the shrill, welcome-home whistle of every shop and plant along the way; when they found themselves once more in the midst of these cheering thousands of their own countrymen,—their hearts filled with that ineffable joy that comes only to those who, after an absence of many weary

months, find themselves once again on their native soil.

And then, to cap the climax, came the welcome each received from his beloved ones—for who was there amidst that happy, joyous throng who did not have some relative or dear friend to greet him upon his return?

However, for the Bell Battalions, there was not merely this warmest of all welcomes from their immediate families, but the added welcome on the part of their official families represented by the great telephone and telegraph organisations from which they were drawn. It was in the nature of a welcome on the part of the fond parent, delighted not only to see his children, but justly proud of their achievements.

For the country had called and they had answered. They had heard the call amply in advance of the immediate demand, and had eagerly sought the opportunity to serve. Carefully selected months before America was actually at war, already expert in the work they were going to perform for Uncle Sam, they had gone through the hard, intensive months of additional training at military camps necessary to fit them for the trying days to come; they had crossed 3000 miles of submarine infested water to a new land where they were to spend many gruelling months of unremitting toil, building up the backbone of wire communication for the A. E. F. and extending the network clear to the edge of No Man's Land; they had succeeded in providing a system of telephone and telegraph communication for a military community of two million men, scattered over the length and breadth of a foreign and unfamiliar country, and reaching into regions hovering in the neighbourhood of the enemy's outposts; they had seen the great issue perilously doubtful,

swaying back and forth, and finally triumphant, and they had participated gloriously in that triumph—the triumph of the A. E. F. operating under a great commander as a single harmonious unit; and they well knew, and were proud to know, that this harmony of action which permitted the victory could not have been attained but for the splendid channels of wire co-ordination which they had supplied.

And now they were civilians once more. Once more they could go about as they pleased, with never an M. P. to say them nay. Once more they could eat what and when they pleased, and sleep likewise, regardless alike of First Call and Taps, details and drill. Once more they could—Oh, it was a grand and glorious feeling!

Each battalion had brought home the flag originally presented by the telephone company from whose organisation the battalion ranks had been recruited. In almost every case the flag was soiled, its fringe ragged, the vividness of its original colouring dimmed. But these facts were not so much evidences of wear and tear, as proof of the patriotic devotion and willingness to sacrifice which they eloquently bespoke.

And therefore each telephone organisation placed these emblems symbolising devotion to duty, where in the years to come they will serve as undying tokens of the loyalty and bravery of telephone men,—not so much a reminder of the past, as an inspiration for the future.

THE END.

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